Enlisted

FIGHTER II

STAFF MEMORANDUM

FIELD STRESS: A PRELIMINARY STUDY OF ITS STRUCTURE, MEASUREMENT, AND RELATIONSHIP TO COMBAT

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This staff memorandum is published for the purpose of preserving the data as collected and analyzed in Phase Two of Task FIGHTER. There are no recommendations for action in this report.

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ABSTRACT

FIELD STRESS: A PRELIMINARY STUDY OF ITS STRUCTURE, MEASUREMENT, AND RELATIONSHIP TO COMBAT. Tor Meeland, Robert L. Egbert, and Irwin Miller

In groups of 19-28, one hundred and forty-eight Fort Ord trainees underwent five consecutive days of psychological testing and performance on seven experimental stress situations involving fire, darkness, height, distraction by explosives, fatigue, and electric shock. A factor analysis of 50 diverse measures of stress performance yielded six major factors. Relationships between life history and personality characteristics of stress performers and combat performers were analyzed. A facilitative effect in the tolerance of electric shock was found with the presence of a partner in the situation.

Primary Field: Psychophysiology of general organic and special environmental stresses. Secondary Field: Identification and measurement of intellectual, emotional, capacitative and attitudinal traits; related performance evaluation.

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Chapter 1
DESCRIPTION OF THE RESEARCH

THE RESEARCH PROBLEM

How may an infantryman's performance in combat best be predicted? Can training programs be evolved which will demonstrably increase a man's ability to perform under the stresses of combat? In this study, FIGHTER II, the problem was attacked by developing and testing controlled stress situations. A previous study, FIGHTER I,[1] provided psychological descriptions of men who performed well in combat, tagged as "fighters," together with descriptions of "nonfighters." The practical objective in FIGHTER II was to relate these descriptive data, grounded in combat, to performance in the controlled stress situations. In this way it was hoped to derive workable combat substitute criteria that could be used to estimate the changes in a man's fighting potential after various amounts of specialized training.

Complementary to the practical research goal, the theoretical concept of stress holds a considerable fascination for psychologists. In such a difficult and complex area as stress, any

[1] See reference 25.

initial attempt to combine numerous laboratory and field situations in one investigation must be considered exploratory. This research program incorporated approaches intended to analyze the nature of stress from several different viewpoints,[1] combining practical and theoretical values. These viewpoints are best expressed in question form.

(1) Is it possible to rank-order stress-producing situations in terms of their relative stressfulness or "cost" to the individual?

(2) Do these stress-producing situations have distinct dimensions? In methodological terms this question asks whether factors identified in a factor analysis may be clearly understood as stimulus factors, response factors, or some intermediate combination.

(3) Are there stable life history and family background correlates of good performance in stress-producing situations that distinguish clearly between good and poor performers? Assuming that life history and family background prove to be important, will a comparable relationship be found in previously collected data representing fighters and nonfighters identified in combat?

(4) Does the fighter questionnaire (IOQ) developed in the Korean conflict discriminate between the good and poor performers in the stress producing situations?

(5) Do the personality traits which describe the fighter in Korea also serve to describe the good performers in the stress producing situations?

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[1] See references 16, 19, and 20.

(6) How is a man's ability to tolerate stress influenced by the presence of a companion, a partner who seems to be enduring the same stress?

(7) Can measures related to stress performance be utilized in a regression equation for predicting combat behavior?

Some ramifications of the problems mentioned above[1] are sufficiently important to merit mention even though this study did not directly assault each problem:

(1) Performance curve as a function of stress intensity: Along the intensity continuum, performance may alter so that a mild stress improves performance, but further increases in stress intensity result in maladapted behavior, with collapse accompanying extreme stress. If these critical points occur, they should be identified and clarified.

(2) Duration of stress: In addition to overall intensity, stress may extend over short or long periods of time. Similarly, intermittent stress of a mild or severe nature may warrant study as a special case in this category.

(3) Complexity of stress: Investigations may be made of stress situations involving lesser or greater degrees of complexity. It is likely that most stresses are quite complex in application.

(4) Reaction to inadequate performance: Qualitatively different reactions on the part of the person who refuses, or fails, to perform a task are possible. He may tend to blame himself, others, or outside circumstances; these alternatives may be differentially significant in a military context.

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[1] See reference 18.

(5) Realism of stress-producing situations: The verisimilitude of the stress situations may be open to experimental attack as a critical variable in its own right.

(6) "Cost" to the individual: The cost to the individual may be measured in terms of such variables as recuperative time, changes in body chemistry, changes in physical coordination and alterations in self-evaluation.

(7) Traditional stress research technique: The body of research on mazes and mirror drawing under conditions of distraction or approval, would seem to justify examination of these devices as correlates of stress performance. It must be pointed out, however, that results of the Korean study indicate that these more traditional stress situations may have little relationship to real performance in combat.

METHOD

Extensive interviews with returned Korean veterans were held in order to elicit from the experiences of experts some common elements of combat behavior and the combat environment. One major outcome of these interviews was a notable lack of agreement on the requirements for combat, and on the particular kinds of circumstances in which the men had found themselves. Despite these differences in particulars, however, two related common elements seemed to pervade most of the combat experiences: extreme fatigue and the lack of sleep. In view of this common agreement, the decision was made to reproduce these essential features of combat by including a strenuous field exercise as an intregal part of the testing program;

in addition to taking tests, the men were to cover about thirty miles of terrain in two days of irregular sleeping and waking periods. One outcome of participation in the field exercise might be that inadequate performances and errors in the stress situations and tests would be exaggerated. While the absolute levels of performance would probably be lowered, a sharpening of the relative differences between stress situations was also anticipated. Administrative limitations prevented testing under varying levels of fatigue; the level chosen was a best guess based on pre-testing experience of the degree of severity which would still permit safe completion of the tests.

In the planning and arrangement of the stress-producing situations two considerations were foremost. First, the situations were designed to be accepted by both the subjects and military coordinators as part of the military environment. There is reason to believe that the physical and psychological demands posed by these tasks lent them a formidable face validity from the viewpoint of both groups. Furthermore, regardless of how threatening and dangerous the situations might appear, they had to be completely safe for the subjects. This second requirement raised the greatest experimental problems since it is exceptionally difficult to devise a situation which appears to threaten life and limb, and yet, is reasonably free of danger.

One further consideration governing the selection of the stress situations involved the necessity of including as wide a variety of circumstances as possible. The aim was systematically

to sample different types of stress-producing circumstances rather than to limit the research to any one type of performance, e.g. in the dark or at great heights. In addition to the stress situations which were oriented in terms of face validity and ease of administration to a military setting, some of the traditional laboratory stress situations, involving electric shock, were also used.

The final test battery included the following conditions: darkness, explosive noises, fires, height, distractions, and electric shock. After each stress situation the Cancelling C's test was administered. Underlying all of these situations was the fatigue and lack of sleep imposed on the subjects in the beginning of the testing week.

THE STRESS SITUATIONS[1]

The Jump Tower

Earlier HumRRO experience with parachute jump training[2] indicated the likelihood that a jump tower situation would provide an adequate degree of stress for the purposes of this study. Each man jumped from a 30 foot tower while strapped in a parachute harness which was attached to a carriage overhead. The carriage ran down a cable on a 30 degree incline. The carriage had a brake on it; the subject was told before the jump that if he was afraid he could slow down the speed of his descent by operating the brake.

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[1] Specific details of the situations and the administrative procedures can be found in Appendix A.

[2] See reference 27.

Examiners measured the length of time it took him to climb the ladder, his latency in jumping following the command to go, and his pulse rate before and after the jump. In addition, his overall performance was rated.

The Dark Room

For this situation each man was sent into a dark room carrying a rifle with fixed bayonet. As he followed a luminous line on the floor, a dummy swung out at him from the front and a scream was heard from a loud speaker. Next, a dummy appeared from the rear, again accompanied by a scream, and finally, a third dummy was illuminated directly in front of the man, while a voice from the loud speaker said, "Get him! Get him!" Each man was scored for his overall performance, the strength of his thrust, his skill in bayoneting, and his reaction time in attacking the third dummy. Pulse rates were taken before and after the dark room situation.

Combat-in-Cities

Each subject moved through a Combat-in-Cities course, firing at electrically operated pop-up silhouette targets, while artillery and hand grenade simulators were detonated around him. At each target, the number of rounds fired, the latency of firing, and the percentage of hits were tabulated. Measurements for each man also included speed of advance at critical points through the course, the number of times he took cover from artillery simulators, his overall time, and an overall performance rating. Firing accuracy was corrected according to his marksmanship as previously determined

under normal conditions on the Known Distance range.

Perimeter Defense

Each man was placed in a stationary position in a perimeter defense situation. Electrically operated pop-up targets were presented in front of him at a range of 60 to 85 yards. He fired at these while artillery and hand grenade simulators were detonated 11 feet behind him, M80 firecrackers were detonated in front of him, and aerial bursts above him. Accuracy scores in this situation were related to normal marksmanship as determined earlier in the week when the men were rested.

Large Oil Fires

As part of the fire fighting training program conducted by the Navy at Treasure Island, simulated ship structures flooded with oil are ignited and the fires then extinguished with water. Two of the fire fighting situations were made available for use in stress situations: the Open Tank Fire, and the Boiler Room Fire.

The Open Tank Fire. A tank, 15 feet in diameter, half-filled with diesel oil, was ignited with gasoline. After flames completely engulfed the tank, each subject approached and tried to put out the fire by cooling the surface of the oil with water from a 1½" hose fitted with a high pressure fog nozzle. He was assisted by four other men who stood behind him and helped manipulate the heavy hose. The fire caused great personal discomfort; the heat was intense, and the only protection a man had from the searing flames was the wall of high pressure fog which he kept between himself and the flames. He was rated for the aggressiveness with which he extinguished the fire.

The Boiler Room Fire. The space below a simulated destroyer boiler room was flooded with oil to within 18 inches of the deck plates. The oil was ignited with gasoline, and when the fire blazed throughout the structure two teams of men entered from opposite hatches and worked together to put out the blaze. Here, again, the heat was intense and accompanied by much smoke. Each subject was rated for performance and aggressiveness when given an opportunity to manipulate the nozzle of the hose.

The Small Oil Fire

This situation was devised to investigate the validity of an inexpensive small-scale duplicate of the Treasure Island Open Tank Fire. A 55 gallon drum, about two-thirds full of motor oil, was ignited. Each man was required to put out the fire with a garden hose, using a very fine spray. Ratings were made of overall performance.

Shock Arithmetic

Sixteen addition problems were presented to each man; he received an electric shock after certain answers. His performance in this shock condition was compared with his performance on another set of sixteen problems which had been done earlier with no shock. Advantage was taken of the shock-arithmetic situation to collect additional data that promised to throw some light on the value of a partner in this stress situation, as contrasted with solitary endurance of the stress.

Supplementary to the seven stress situations, several laboratory tests were given with electric shock as a producer of

stress. These were reaction time, tapping speed, two hand coordination, hand tremor, weight discrimination, time estimation, and change in pulse rate due to threat of shock. These situations were scored according to the percentage of change with respect to performance under normal conditions.

THE SUBJECTS

Several sampling requirements limited our selection of the men who were to undergo the testing program. Men with previous military experience were not considered, nor, for administrative reasons, were men who were not scheduled for a second eight weeks of basic infantry training. In addition to having an "A" profile,[1] the men were required to pass a medical examination. From each of six companies, 30 subjects were randomly chosen so that the distribution of their Aptitude Area I scores and fighter potential (IOQ) scores would approximate that of the entire company. Eventually, a total of 148 subjects were tested. Table 1 summarizes the sources of the subjects and the size of the sample.

TESTING SCHEDULE

The men were tested for five consecutive days in groups of 19-28. A different group was tested each week for six weeks.

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[1] AR 40-503. "A" profile men are capable of maximum effort for extremely long periods of time. They are able to do hand-to-hand fighting, running, climbing, digging, and participate in long marches. They have good hearing and vision, and are without psychiatric disorders.

Table 1

SOURCE OF SUBJECTS AND SAMPLE SIZE

Group No	Original Co.	N	Qualified[a] N	No.[b] Selected	No.[c] Tested	Week Tested
I	A	180	57	30	28	Mar 14-19
II	B	180	27	24	19	Mar 21-26
III	C	185	27	27	26	Mar 28-Apr 2
IV	D	180	40	30	28	Apr 4-9
V	E	225	69	30	26	Apr 11-16
VI	F	200	74	30	21	Apr 18-23
TOTAL		1150	294	174	148	

a/ Subjects had to be scheduled for Advanced Infantry Training and must have had no previous military experience.

b/ Randomly selected to match the distribution of entire company on AAI and IOQ scores.

c/ Attrition here is due to failure to pass medical examination.

The weekly testing schedule is summarized in Tables 2 and 3.[1] Each Monday morning, the general nature of the research activities carried out by Human Research Unit No. 2 was explained and an indication given of the kinds of activities in which the men would participate during the week. Care was taken not to reveal the purposes of the study. The men were requested not to communicate with anyone about the testing experiences until the entire series of tests were completed.

The subjects spent the first morning drawing weapons and firing for record on a Known Distance range. This score was later used as a base line for their marksmanship performance in the Perimeter Defense and Combat-in-Cities situations. In the afternoon physical examinations were given and blood samples taken for the eosinophil measure. The men then took a physical fitness test consisting of the Army test, and additional measures of agility, balance and flexibility.

After the evening meal the men drew their field equipment and at 9 p.m., started a psychological testing program which continued until 3:30 Tuesday morning. This testing session served two purposes: (1) providing psychological information and background material which could later be related to their stress performances, and (2) Keep the subjects awake. The men were permitted to sleep from 4 a.m. to 5 a.m. At 8 a.m. Tuesday they started on a 29 mile march which was spread out over eighteen hours, ending at about 2 a.m. Wednesday morning. The men were then allowed to

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[1] A detailed description of the testing program, including the briefing, is available upon request. See Appendix E.

Table 2

BASIC WEEKLY SCHEDULE FOR ALL SUBJECTS

Monday

0500 - Reveille
0530 - Chow
0745 - Briefing Bldg. 3742
0800 - Pictures, Bldg. 3742
0845 - Draw weapons
0930 -1115 - Zero weapons and fire for score
1130 - Chow
1300 - Physical exams
1530 - PFT (physical fitness test)
1715 - Chow
1800 -1900 - Draw equipment
2100 -2400 - Psychological Testing

Tuesday

0001 - Coffee &/or soup
0015 -0330 - Testing (cont'd)
0500 - Reveille
0530 - Chow
0800 - Move out on march
1230 -1330 - Chow
1330 -1700 - Patrol
1700 -2000 - Chow and rest
2000 - Depart on march
2300 -2400 - Coffee and soup
2400 - Continue on march

Wednesday

0200 - Arrive at barracks
0500 - Reveille
0530 - Chow in Btry area
0700 -0745 - Firing KD range
0745 -0845 - Blood tests
0900 -1700 - Field stress tests
1130 -1230 - Chow
1300 -1630 - Field Tests (cont'd)
1700 - Chow
1800 -1900 - Clean weapons
1900 - Turn in weapons and equipment

Thursday

0230 - Reveille
0300 - Chow
0730 - Arrive Treasure Island
0800 -1100 - Fire fighting
1100 -1300 - Chow
1300 -1600 - Fire fighting
1600 -1730 - Chow
2030 - Arrive Fort Ord

Friday

0515 - Reveille
0530 - Chow
0800 -1130 - Laboratory stress tests
1130 -1230 - Chow in Btry.
1300 -1600 - Laboratory stress tests
1600 -1630 - Debriefing
1700 -1800 - Chow in Btry.

Saturday

0800-1100 - Clear Btry.

Table 3

SUMMARY OF TESTS ADMINISTERED[a]

1st Week Basic Training: Fighter Potential Test - Form A (25)

Monday -
1500 hours Physical Fitness Test (10)
2100 hours to 0330 hours

1. Cancelling C's (18)
2. Cube fluctuation)
3. Battery H) Group Objective Tests (3)(4)(5)
4. CMS)
5. Battery G)
6. Culture Free Intelligence Test - Form B (6)
7. Picture preference (25)
8. Copied Design (3)
9. 16 PF - Form B (8)
10. IPAT Humor Test - Form B (7)

Wednesday
0900 - 1700 hours

A. Field Tests (Cancelling C's given after each)

1. Oil Fire
2. Jump Tower
3. Combat-in-Cities
4. Dark Room
5. Perimeter Defense
6. Shock (Arithmetic Problem)

B. Battery X - These group administered tests were given on Wednesday, continued at Treasure Island on Thursday, and concluded on Friday.

1. Strong Vocational Interest Blank (22)
2. Military Information Test - 150 items (26)
3. Fighter Potential Test - Form B (25)
4. Picture Projective Test (25)
5. Study of Choices - Form VIII
6. Guilford-Zimmerman (14)
7. California Psychological Inventory (13)
8. IPAT Humor Test - Form A (7)
9. Life History Inventory (25)
10. Word Suggestion Inventory (9)
11. Fighter Potential Test - Form A (25)
12. 16 PF - Form A (8)
13. Barron Ink Blots (1)
14. Culture Free Intelligence Test - Form A (6)

[a] Bracketed numerals refer to bibliography.

Table 3 (cont'd)

Thursday -
0800 - 1530 hours

A. Fire Fighting at Treasure Island (Cancelling C's given after each fire)

1. Open Tank Fire
2. Boiler Room

B. Battery X - (continued)

Friday -
0800 - 1530 hours

A. Battery X - (concluded)
B. Individual Objective Tests (4)(3)(5)

1. Battery A - Flicker fusion; mazes
2. Battery B - P.G.R., Blood Pressure; Pulse Recovery; Body Type
3. Battery C - Mirror Drawing; Body sway; Time estimation; Pulse change in stress
4. Battery D - Reaction Time; Time estimation
5. Battery E - Tapping; Two hand coordination; Tremor; Weight estimation

1530 hours:

Sociometrics
Rating of situations
Clothing and equipment check list

sleep until reveille at 5 a.m. Once again they fired the Known Distance range while fatigued and had another blood sample taken.

For the remainder of Wednesday, the men were evaluated on six of the stress situations described above, and several interspersed paper and pencil tests. The men were permitted to sleep from 6:30 p.m., until 2:30 a.m., Thursday morning. They then boarded a bus for a three hour trip to the Navy Fire Fighting School at Treasure Island, where they underwent the next stress situation, fighting large oil fires.

Friday, after a normal night's sleep, the men once more took paper and pencil tests and individual psychological tests. A debriefing was held late Friday afternoon, when they were again urged not to communicate with anyone about what they had experienced.

CLASSIFICATION OF RESEARCH RESULTS

Two broad classes of results may be discriminated. On the one hand are those analyses that were confined strictly to the stress situations. These include:

(1) An evaluation of the relative stressfulness of the various situations, (Chapter 2), and

(2) A factor analysis of the possible dimensions that underlie the stress situations (Chapter 3).

Contrasted with these internal analyses is a larger group of external analyses. Chapters 4, 5, and 6 deal with external relationships to the stress situations and include five separate analyses:

(3) The relationship of life history and background material to performance in the stress situations.

(4) Relationship of the fighter potential scale to performance in the stress situations.

(5) An analysis of the personality traits which described the fighter in Korea in respect to their efficiency in predicting stress performance.

(6) The influence of a partner on the shock tolerance of a subject (Chapter 5).

(7) A regression analysis to examine how efficiently equations incorporating the stress situations as dependent variables also serve to identify the fighters in the Korean study on a basis of common traits (Chapter 6).

Chapter 2
INTERNAL ANALYSIS I
EVALUATION OF THE STRESS SITUATIONS

Five potential criterion measures were integrated into the testing program in order to evaluate the relative stressfulness of the various situations: eosinophil count, the Cancelling C's test, rating by expert judges, ranking by the subjects, and sociometric choice. Performance on the Treasure Island Fires was also analyzed to see if it could be used as an intermediate criterion by which to rank-order the remaining situations.

EOSINOPHILS

In evaluating the stress situations, a principal objective was to assess the "costs" to the individual of the stress situation. The main difficulty was determining a well-founded index which would carefully and accurately reflect the degree of fatigue and/or stress in some measurable outcome. Some possible physiological indices included eosinophils, the presence of 17-Ketosteroids in the urine, and blood sugar changes.

For reasons of experimental expediency, eosinophils were chosen for the present study in preference to the other physiological measures. While the original plan was to take eosinophil counts

after each of the stress situations, a shortage of personnel at the Fort Ord hospital made it necessary to restrict the taking of blood samples to three occasions only: at the beginning of the week when the subjects were rested, after the fatiguing march, and immediately following the Treasure Island fire fighting experiences.

Following the first week of testing, a further shortage of hospital personnel made it impossible for them to perform the blood analysis. In the remaining five weeks the eosinophil counts were made by three hastily-trained psychologists whose counts were checked against those of the hospital technicians. The varying intervals, from 2 to 24 hours, between the drawing of blood and the actual count imposed an unknown error. However, precautions were taken for the refrigeration and preserving of the blood samples.

An analysis of variance on the eosinophil data is presented in Table 4 and in Figure 1. It is clear that any between-days effect, i.e., a result of the stress treatment, is obscured by the huge between-weeks and weeks-days variances. While the drop as a result of the long march appears large, its large week-to-week variance (whether due to group differences or experimenter differences) prevents its unequivical acceptance.

One unavoidable difficulty inherent in the use of eosinophils as a stress index has been noted by previous researchers.[1] In common with other physiological measures, a very generalized responsiveness to stresses of all kinds seems to be characteristic,

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[1] See references 2 and 24.

Table 4

ANALYSIS OF VARIANCE FOR EOSINOPHIL DATA

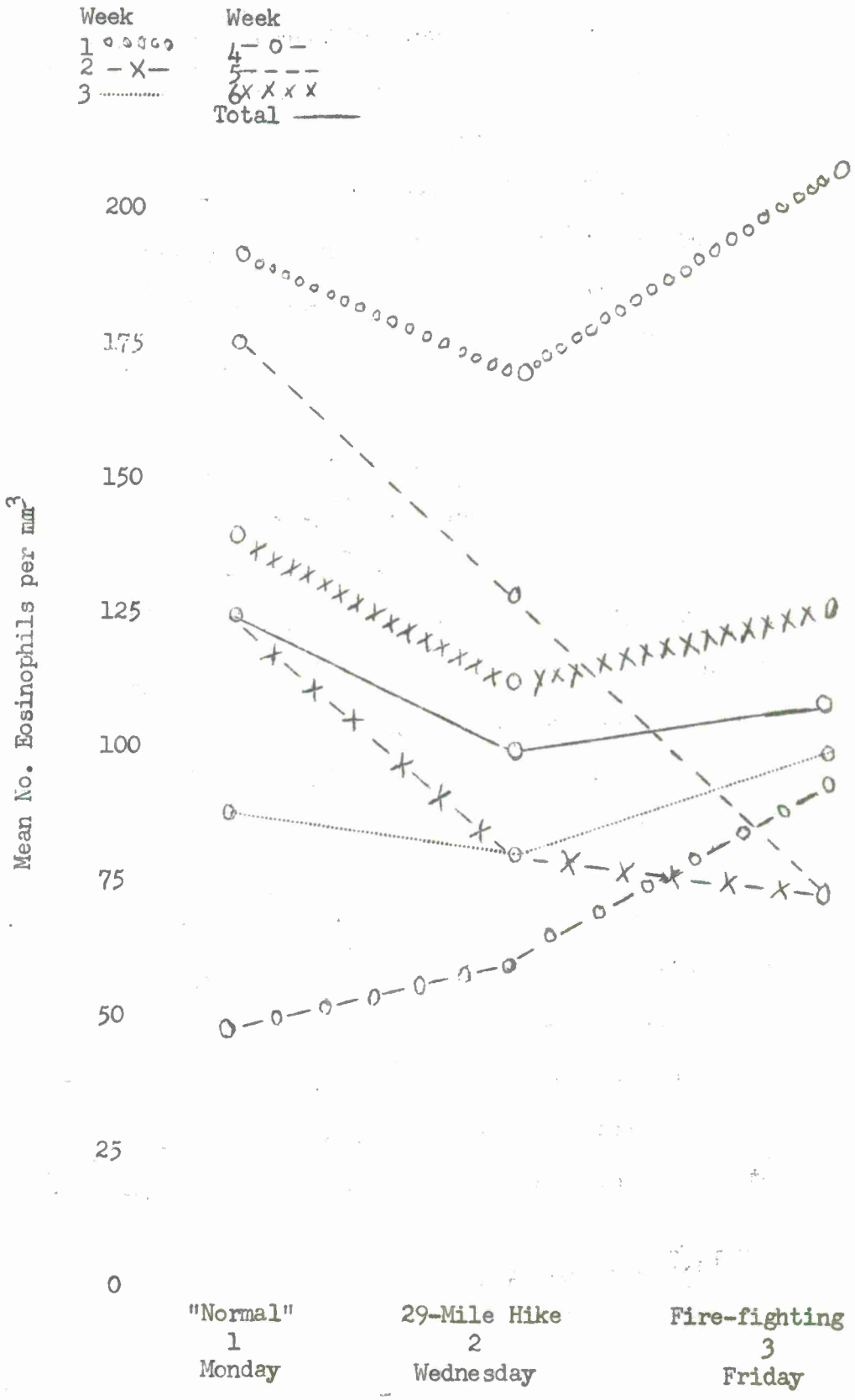
Source	Degrees of Freedom (N-1)	Mean Squares	F
Between Weeks	5	106,812	91.29**
Error	114	1,170	
Between Subjects	119	5,608	
Between Days	2	11,941	3.45*
Interaction-weeks x days	10	140,938	40.80**
Error	228	3,454	
Within Subjects	240	9,253	
Total	359		

**Significant at the .01 level or less
*Significant > .05

Note: If between-weeks and between-days effects are evaluated over alternative error terms involving days x weeks interaction variance, then the significance disappears.

Figure I

Mean Number of Eosinophils/mm^3 by Day and Week (mm^3)



with changes in eosinophil levels having been noted before such differing stimuli as parachute jumps, final examinations, Caesarean section, fever and fatigue. Furthermore, it is not unlikely that the variations from week to week may reflect the procedural shortcomings mentioned above.

In any event, the differences from week to week are sufficiently large to make suspect any conclusions concerning the day-to-day differences. When the results of the six groups are averaged, the eosinophil count is significantly different at the .05 level from day to day. When each week is considered separately, however, only the fourth and fifth week showed significant differences, at the .05 and .001 levels respectively. The fourth week's subjects showed counts which went up from normal under the stress. In the fifth week the counts dropped. These results indicate that little confidence may be placed in the eosinophil measures as used here, and, therefore, that they cannot be used to assess the relative stressfulness of the situations in this study.

CANCELLING C'S

On the basis of previous research indicating that it showed promise as a stress sensitive measure,[1] the Cancelling C's test was used extensively in the present study. A base line was established on Monday when the men were rested. At the conclusion of the jump from the tower the subject was given a Cancelling C's test, and he took the same test following Combat-in-Cities, Perimeter

[1]See reference 18.

Defense, Treasure Island Fires, Small Oil Fire, Dark Room and the Shock-Arithmetic situation. Since the order in which the subjects underwent the various stress situations was not entirely constant, the sequence of the Cancelling C's test is known only for the first testing in the normal control condition, and the last two testings after the Treasure Island fire fighting.

In Table 5, the mean number of C's cancelled and the mean percentage of errors (i.e., of C's not cancelled) for each of the situations is given with the standard deviations. The number of C's cancelled following the Tank Fire and Boiler Room situations exceeded that of the normal testing. This almost certainly reflects a learning process, that is, increasing familiarity with the test. The percentage of error demonstrates that the most accurate performance occurred in the normal condition, while the most errors occurred in the Open Tank Fire and Boiler Room Fire. As borne out by the analyses below, these fire situations were considered the most stressful of all the situations, but there is the slight possibility of a specific smoke effect on the eyes accounting for the results.

Since it was not possible to control certain important conditions, the Cancelling C's data are open to some question. For example, some of the men passed through the Combat-in-Cities course on a dead run, without seeing the targets or firing at them. The exercise involved in running may well have lowered the scores more than the stress of any of the special circumstances in the situation. On the other hand, the Cancelling C's tests following the Dark Room and Shock-Arithmetic situations were administered indoors, seated at

Table 5

CANCELLING C's: Rank Order for Number Cancelled and Percentage of Errors Following the Stress Situations (Error = failing to cancel C)

Number Cancelled

	Situation	Mean	σ	N
1.	Normal	27.7	7.87	142
2.	Small Oil Fire	28.4	9.93	137
3.	Dark Room	28.5	4.26	125
4.	Shock Arithmetic	30.7	6.50	133
5.	Jump Tower	32.6	5.68	130
6.	Perimeter Defense	33.4	5.22	134
7.	Combat-in-Cities	33.5	5.79	112
8.	Boiler Room Fire	33.7	5.27	126
9.	Tank Fire	34.8	5.61	127

% Errors

	Situation	Mean	σ
1.	Normal	270	0448
2.	Dark Room	483	0791
3.	Jump Tower	513	0869
4.	Perimeter Defense	526	0738
5.	Fort Ord Oil Fire	599	0780
6.	Shock Arithmetic	679	0697
7.	Boiler Room	780	0780
8.	Combat-in-Cities	785	0778
9.	Tank Fire	888	1426

a table. Although these adventitious factors prevent our ranking the situations in terms of degree of stressfulness, the evidence does not deny that the Cancelling C's test still has possibilities for assessing individual involvement in stress situations.

RATINGS OF THE SITUATIONS BY EXPERT JUDGES

Each of eight experienced combat officers, whose ranks ranged from first lieutenant to colonel, rated all the situations as to the amount of stress produced. Most of the officers had extensive combat experience. These results are shown in Table 6. Regarding Open Tank Fire, one officer checked that it produced "a great deal of stress," three indicated it produced "considerable stress," while one said it produced "some stress." Three officers could not respond to this item ("no response "), because they did not observe fire fighting at Treasure Island.

After completing the ratings, six of the experts were also asked to rank-order the situations according to their stressfulness. The five situations so ranked are presented in Table 7. The Treasure Island situations would actually top the lists if data were used only from officers who observed all 7 situations.

It should be stated that these officers were aware of the purposes of the research, i.e., the orientation towards combat, and undoubtedly expressed this awareness in their rating. They clearly rated as low in stress the Shock-Arithmetic, Combat-in-Cities and Small Oil Fires situations. Essentially the same ordering of the situations occurred when the experts simply ranked the various problems. The rho between the rankings and the ratings by experts is .88, a value attenuated by ties in the rankings.

Table 6

RATING OF SITUATIONS BY EXPERTS

Situation	Great Deal of Stress (5)	Considerable Stress (4)	Some Stress (3)	Very Little Stress (2)	No Stress (1)	No Response (0)	Mean Rating	Rank of Mean Rating
1. Boiler Room Fire	1	2	2			3	3.80	3
2. Open Tank Fire	1	3	1			3	4.00	1
3. Dark Room	1	3	1	1		2	3.67	4
4. Jump Tower	1	5	2				3.88	2
5. Shock Arithmetic			3	1		4	2.75	6.5
6. Perimeter Defense	1	4	2	1			3.63	5
7. Combat-in-Cities		1	4	3			2.75	6.5
8. Small Oil Fire		1	1	4	2		2.13	8

Table 7

RANKINGS OF STRESSFULNESS OF SITUATIONS

Situation	Ordering of Mean Ranks by 99 Subjects	Ordering of Median Ranks by:	
		6 Experts	99 Subjects[xx]
Boiler Room Fire	1 (most stressful)	*	*
Oil Tank Fire	2	*	*
Dark Room	3	2.5	2
Jump Tower	4	2.5	1
Shock-Arithmetic	5	*	*
Perimeter Defense	6	1	3
Combat-in-Cities	7	4	4
Small Oil Fire	8 (least stressful)	5	5

* Since the Oil Fires were observed by only 5 experts and the Shock-Arithmetic by 4 experts, these situations are not considered in the median rankings

[xx]Median ranks were obtained for subjects for purpose of comparison with experts.

RANKING OF THE SITUATIONS BY THE SUBJECTS

At the end of the test week each subject was asked to rank the situations in order of intensity of stress. The subjects were instructed to "rank the situation according to how much it scared you, how much it bothered you, or how much it upset you." A pointed attempt was made to translate "stressfulness" into sufficiently concrete detail for the subject to comprehend its meaning.

Inspection of Table 7 shows a marked similarity in the rankings made by the subjects and the rankings made by the experienced officers. The main difference in the ordering occurred for the Perimeter Defense situation, judged more stressful by the officers. Verbal comments by the officers suggest that they experienced a significant association to the whistle emitted by the artillery simulators. Undoubtedly, this whistle followed by the explosion was sufficient to produce much of the feeling of combat for the officers. This was certainly not the case for the subjects, many of whom were unaware of the significance of the whistle. In spite of the anomaly presented by the Perimeter Defense ranking, the rank-order correlation between the subjects' and the experts' ranking is ρ .92, indicating substantial agreement. If all eight situations are ranked (by varying numbers of experts) Rho = ρ .81.

TREASURE ISLAND FIRES

One likely equivalent of combat which can be found in peacetime is the fighting of fierce fires. Several of the fears and perils often associated with combat are present in this activity.

There is apparent danger of injury or loss of life and extreme, often painful, heat. For these reasons the fighting of oil fires was accepted by the experimenters on rational grounds as a rough approximation to combat.

It is noteworthy that both the participating subjects and the expert observers rated the Treasure Island oil fires as the most stressful situation after experiencing all the field stress situations. This finding argues for accepting the oil fires as an intermediate criterion by which to rank-order the remaining field stress situations.

Obtaining objective and reliable rating of performance proved to be a major difficulty in the fire situations. Time measurements were found inadequate because of the influence of wind strength and direction on the duration of the fire, as well as the difficulty of accurately determining when each subject started and finished the actual fire-fighting. The measure finally used was an overall rating of "aggressiveness" assigned to a subject by the observing psychologists. The correlations between the psychologists and the two Navy Chief Petty Officers in rating the tank fire and the boiler room fire were .38 and .34, respectively. Comparable relationships were obtained for various pairs of psychologists for the tank fire; these are shown in Table 8. The confining dimensions of the boiler room and the presence of thick smoke made it impossible for more than one rater in addition to the CPO to observe the subject adequately. Thus the estimate of rating reliability for the boiler room fire is between any one psychologist and

Table 8

INTER-RATER AGREEMENT FOR THE OIL FIRES

A. Tank Fire

				r	N
1.	Psychologists	vs	CPO's	.38	133
2.	Psychologist B	vs	Psychologist S	.28	46
3.	Psychologist E	vs	Psychologist S	.56	32
4.	Psychologist E	vs	Psychologist B	.45	66
5.	Psychologist M	vs	Psychologist B	.14	20
6.	Psychologist E	vs	Psychologist M	.26	20
7.	CPO A	vs	CPO B	.13	20

B. Boiler Room Fire

1.	Psychologists	vs	CPO's	.34	133

the CPO. All the fire fighting scores used in subsequent analyses employ only the ratings made by the psychologists.

Table 9 presents the correlations that were computed to estimate the feasibility of using the oil fires as an intermediate criterion relative to the other stress situations. The only stress situation significantly correlated with the Treasure Island oil fire is Perimeter Defense. Consequently, the stress situations cannot be ranked in terms of magnitude of correlation with the oil fires.

SOCIOMETRIC CHOICE

In predicting an individual's behavior an important source of information is the judgment of his peers. Despite the unsophisticated directness of this measure, there is evidence that it has utility in the prediction of performance.[1] On this basis, an investigation was made of the relationship of peer ratings to performance in the stress situation. Each subject received a pooled rating based on the frequency with which he was named in response to the question, "Who would you like to have with you in combat?"

This rating was made at the end of the testing week when the subjects were assembled for the last time and required to rank one another on several different traits, including the sociometric choice for combat. The details of this rating can be found in Appendix D.

The correlations between popularity and the six situations

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[1] See references 12, 15, and 21.

Table 9

PRODUCT-MOMENT CORRELATIONS BETWEEN
FORT ORD STRESS SITUATIONS AND OIL FIRE FIGHTING
(N = 86 - 135)

	Oil Fire
Dark Room	-.14
Jump Tower	-.12
Shock-Arithmetic	.15
Perimeter Defense	.26*
Combat-in-Cities	.05

*Significant at .05 level.

are given in Table 10. In only one situation, the Jump Tower, did good performance have a significant correlation with the sociometric choice, r = -.23, i.e., popular subjects did better. There is reason to suspect that this correlation coefficient is unduly inflated.[1] During each of the six weeks two different subjects refused to go off the jump tower. Undoubtedly, knowledge of this refusal became known to the rest of the subjects in the two days preceeding the peer ratings.

SUMMARY

The most significant evidence that the situations could be ordered by intensity of stress was found in a comparison of the rank accorded the situations by the subjects themselves, and by expert judges. This evidence indicates that, in both rankings, the Treasure Island oil fires were most stressful. We may point out here, that these fire situations unquestionably possess a "realistic" aspect that may well have been an over-riding determinant.

Some evidence favoring further research with the Cancelling C's test as a criterion measure was also found. The attempts to utilize other criteria such as eosinophils and the sociometric choices proved inconclusive for the reasons described above.

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[1] Evidence of the relatively large differences among the stress situations was provided by a correlation matrix computed for the multiple correlation analysis reported in Chapter 6. The intercorrelations of scores representing performance in each situation tended in general to be low and nonsignificant. Only three significant correlations were found: Perimeter Defense and Large Oil Fires (.26), Perimeter Defense and Combat-in-Cities (.25), Shock-Arithmetic and Jump Tower (-.23). This last negative correlation lends support to an interpretation offered at the conclusion of Chapter 4 regarding the type of stress represented in the Shock-Arithmetic situation.

Table 10

PRODUCT-MOMENT CORRELATIONS BETWEEN STRESS SITUATIONS AND SOCIOMETRIC CHOICE

(Low sociometric score = most preferred to be alongside in combat)

Dark Room	-.17
Jump Tower	-.23*
Shock-Arithmetic	-.04
Perimeter Defense	-.10
Combat-in-Cities	.04
Large Oil Fires (Combined)	-.23*

*Significant at .05 level.

Chapter 3
INTERNAL ANALYSIS II
THE FACTORIAL DIMENSIONS OF STRESS PERFORMANCE

Within the framework of the wide array of test circumstances studied, a factor analysis was performed in an attempt to delineate quantitatively the particular factors contained in the stress situations. Conceivably the situations could be considered as simple entities, so that Combat-in-Cities could be viewed as one distinct stress circumstance, the Jump Tower as another, the Treasure Island fires as a third, and so on. Possibly certain types of reactions might recur regardless of the situation which evolved them.

Fifty widely diversified stress measures were intercorrelated with product moment r's. The N consisted of 100 subjects for whom the data were complete. The magnitude of the correlations was generally low, but in view of the early objective of finding as many varied and separate measures of stress as possible, the low correlations were not unexpected.

The 50 x 50 correlation matrix was factored by the multiple group centroid method. Ten factors were extracted before the residual correlations became negligible. The factors were

rotated to simple structure by the analytic rotation scheme of Thurstone,[1] with a few hand adjustments to improve the final pictures. The simple structure appeared to be adequate and the angles moderate. The intercorrelation matrix, the unrotated factor matrix, Vo; the rotated factor matrix, Vn; the transformation matrix Λ; and the cosine of the angular separations of the factors $\Lambda\Lambda$, are given in Appendix B along with full descriptions of the variables. The factors have been arranged in descending order of mean contribution to the variance of all variables.

In considering the descriptions and interpretations below, it must be borne in mind that the meaning of the factors described in the verbal labels is tentative and reflects a first best guess as to the essence of the dimension. All loadings are considered in the positive direction with titles of tests indicated as needed. The original signs can be examined in Table 3 of Appendix B.

[1] See reference 23.

FACTOR A

Table 11

FACTOR A - INTELLIGENCE

Variable No.	Loading	Variable
33	.77*	High Aptitude Area I
34	.68*	Good Knowledge of military subjects (MIT)
35	.62*	Potential Fighter (High IOQ; measured in first week basic training)
25	.43	Faster reaction time under shock
43	.38*	Many C's cancelled (total of Wednesday and Thursday tests)
50	.36*	Decrease in marksmanship due to PD explosions
20	.32	Shock: % increase in arithmetic errors due to shock

*Highest loading for variable

Factor A is clearly one of intelligence with Aptitude Area I loading highest and appearing in no other factor. The Military Information Test and the Fighter Scale are consistent in their correlations with this factor. The MIT has no significant loading in any other factor, while the Fighter Test has its only other significant correlation (-.30) in Factor F.

FACTOR B

Table 12

FACTOR B - DELIBERATE ACCURACY UNDER STRESS
(CANCELLING C'S ERRORS)

Variable No.	Loading	Variable
48	.72*	Decrease in C's omitted due to Thursday Tank Fire
49	.62*	Decrease in C's omitted due to Thursday Boiler Room.
47	.60	Decrease in C's omitted due to Wednesday field test
25	.49	Slowing of reaction time under shock
18	.35*	DR: Fast in reacting to stationary dummy
9	.34*	CIC: Low % hits
12	.31*	PD: Many rounds fired
13	.31*	PD: Low % hits
4	.28	CIC: Fast travel through course
7	.26	CIC: Many rounds fired
5	.23*	CIC: Long time to first building re. total time

*Highest loading.

Simply to consider this a Cancelling C's test factor is one possibility. However, under conditions of extreme fatigue (Wednesday field tests) and the stress of oil fire fighting, the lack of an accompanying increase in errors committed, might well argue for deliberateness in performance accuracy. Since Variables 9, 18, 12, and 13 have their highest loading in this factor, they probably should be given more consideration than their loadings indicate. The low percentage of hits in CIC is in agreement with the fast travel through the course, Variable 4, and is accompanied by many rounds fired. This circumstance repeats in PD, where many rounds fired again accompany a low percentage of hits. There is, however, in Variable 18, a fast reaction to the stationary dummy in

the Dark Room (uncorrected for a base line of reaction time with the bayonet) but a slower reaction time under shock as compared to normal. The apparent disagreement between these two tests may be attributable to either the difference in type of score used (simple speed vs. % change) or to the problem of small vs. large muscle movement. If it can be assumed that the Cancelling C's test reflects reactions to stress, then it becomes reasonable to consider this factor an accuracy index to the effects of stress.

FACTOR C

Table 13

FACTOR C STRESS PERFORMANCE INDEX
(NUMBER OF C'S CANCELLED)

Variable No.	Loading	Variable
25	.61*	Faster reaction time under shock
46	.59*	Increase in C's done due to Thursday Boiler Room
45	.59*	Increase in C's done due to Thursday Tank Fire
44	.58*	Increase in C's done due to Wednesday field tests
43	.53	Many C's cancelled (total of Wednesday and Thursday Tests)
50	.32	Decrease in marksmanship due to PD explosions

*Highest loading

Factors C and B demonstrate a very clear division occurring between number of C's cancelled and number of errors committed. This factor, C, contains the test scores which, it has been argued, are stress sensitive.[1] If there is validity in this viewpoint, a stress

[1] See reference 18.

performance index of a paper and pencil form using perceptual motor skills may have been isolated. The factor reaction time under shock, Variable 25, which tops Factor C, reflects speed of output and, as such, is not inconsistent with the remaining variables. Although the Cancelling of C's test was considered separately for the Wednesday field tests and for each of the Treasure Island oil fire fighter tests, the total C's cancelled, Variable 43, has essentially as high a loading as Variables 44, 45, and 46. This measure of productivity in the face of stress may indicate that the part scores are unnecessary.

FACTOR D

Table 14

FACTOR D - EOSINOPHILS STRESS INDEX

Variable No.	Loading	Variable D - F1
40	.73*	High Eosinophils - Monday pre-test
48	.65	Decrease in C's omitted due to Thursday Tank Fire
42	.54*	High Eosinophils - after fire fighting - Thursday
41	.38*	High Eosinophils - after hike - Wednesday
15	.32	DR: Slow movement through room

*Highest loading

Since the eosinophil data were discouraging in terms of weekly consistencies, and the blood counts were made at varying intervals of time following the blood taking, it is surprising to see each of the eosinophil scores coming out in one factor only. The scores used were simply the count made on the three occasions with no corrections for base line. The Cancelling of C's errors following

Tank Fire, Variable 48, is the only "C" score to share another factor. The eosinophil scores order themselves in this factor just as they did in the separate analysis, i.e., normal or rested count, post-fire fighting and post-hike. This would seem to argue that this factor represents essentially the number of eosinophils after different circumstances. From the evidence reported elsewhere, we know the eosinophil is only a gross index of stress; it reacts similarly with fatigue, anxiety and stress.

It is significant that the C errors following the most threatening of the stress situations (Tank Fire) occurs in this factor. Its presence here may argue for the use of eosinophils as a stress index.

FACTOR E

Table 15

FACTOR E - PERFORMANCE IN THE DARK

Variable No.	Loading	Variable
17	.76*	DR: Poor performance rating
16	.69*	DR: Weak thrust strength
15	.47*	DR: Slow movement through room
49	.35	Decrease in C's omitted due to Thursday Boiler Room
47	.33*	Decrease in C's omitted due to Wednesday field tests
18	.25	DR: Slow in reacting to stationary dummy
28	.20	Shorter time estimation under shock

*Highest loading

Here is a case where a factor parallels a situation, i.e., the Dark Room. It is no surprise that the Dark Room performance rating possesses the highest loading, since the other Dark Room variables had been scored before the rating was made. A possible

confusion arises as to whether this factor represents performance in the dark or bayonet performance alone. Further work could perhaps distinguish between these two views.

FACTOR F

Table 16

FACTOR F - FIRE FIGHTING PERFORMANCE

Variable No.	Loading	Variable
24	.57*	Poor rating - Boiler Room
23	.37*	Poor rating - Open Tank
30	.37	Little increase in tremor contacts under shock
14	.37*	Oil Fire: Poor performance rating
50	.33	Decrease in marksmanship due to PD explosi
36	.31*	Poor Combat rating
35	.30	Potential nonfighter (IOQ; measured in firs week basic training)
21	.29*	Shock: % increase in latency due to shock
19	.28*	Shock: Low level of self shock
10	.27	JT: Slow ladder climb

*Highest loading

Factor F is perhaps one of the most striking factors of the study. Prior to the testing, the argument was made that fire fighting could be considered the nearest approximation to combat performance and, as such, it is viewed as a possible criterion for the other stress situations. Factor F apparently reflects poor performance in fire fighting. There is a low or poor rating in the Boiler Room or Open Tank and also a poor performance rating in the Small Oil Fire constructed at Fort Ord. The Small Oil Fire, Variable 14, has its highest loading in this factor, as does the fighter scale (potential nonfighter). The presence of the Small Oil Fire in this factor is a surprise, since the raw correlations were not sufficiently high to

indicate this relationship with the Treasure Island situations. There is also a decrease in marksmanship in the Perimeter Defense due to the distractions of explosives. The presence of Variable 30 might appear somewhat of an anomaly in that, along with poor performance in fires, a large increase in tremor contacts under shock could be expected.

FACTOR G

Table 17

FACTOR G - CARDIOVASCULAR EFFICIENCY IN STRESS

Variable No.	Loading	Variable
38	.55*	Increase in Pulse Rate after jump (re normal)
37	.49*	Increase in Pulse Rate before jump (re normal)
39	.48*	Increase in Pulse Rate after dark room (re normal)
47	.28	Decrease in C's omitted due to Wednesday field tests
2	.28*	Poorer maze performance under disturbance
10	.26	JT: fast ladder climb
13	.26	PD: Low % hits

*Highest Loading

This factor could also be called Pulse Rate Change in Field Stress Situations. Since the pulse rates here were taken before and after the Jump Tower and after the Dark Room (both situations requiring physical effort), the absence of a pulse rate change due to the threat of shock is significant. Compare with Factor H below.

FACTOR H

Table 18

FACTOR H - RESPONSE EFFICIENCY

Variable No.	Loading	Variable
1	.47*	Little increase in pulse rate due to threat of shock
8	.43*	CIC: Quick to fire at targets
22	.43*	Shock: % increase in sustained shock (with buddy present in circuit)
36	.31*	Good combat rating
32	.30*	Decrease in wt. disc. accuracy under shock
10	.29*	JT: Fast ladder climb

*Highest loading

The variables involved in Factor H all have their highest loadings here, although none of them is exceptionally high. The threat of shock (in a laboratory setting) has no appreciable effect on the pulse rate. There is a fast reaction in Combat-in-Cities to suddenly produced targets (i.e., short latency in firing), and a good combat rating by peers. Of considerable importance is Variable 22, which reflects a higher tolerance for shock in the presence of a buddy who is perceived as sharing the shock. The factor seems to reflect a "rising to the occasion."

FACTOR I

Table 19

FACTOR I

Variable No.	Loading	Variable
11	.58*	FT: Short hesitation in jumping
29	.55*	Little increase intremor contact time under shock
30	.48*	Little increase in tremor contacts under shock
23	.28	Poor rating - Open Tank
22	.24	Shock: % increase in sustained shock (with buddy present in circuit)
27	.20*	Faster tapping speed under shock
13	.20	PD: Low % hits

*Highest loading

In this instance, it appears the subject is not affected by shock in terms of tremor, nor is he hesitant about jumping off the tower. The poor rating on the Open Tank, Variable 23, seems a contradiction to this, but the relatively low loading of the Open Tank on this factor may minimize the discrepancy. On the other hand, the subject sustains more shock with a buddy present. It is difficult to subsume these variables under a heading of Tower Jumping. Indeed, little can be said of the factor.

FACTOR J

Table 19

FACTOR J RESIDUAL

Variable No.	Loading	Variable
6	.59*	CIC: Takes cover often
20	.37*	Shock: % decrease in arithmetic errors due to shock
4	.34*	CIC: Slow travel through course
48	.24	Increase in C's omitted due to Thursday Tank Fire
51	.23	Decrease in marksmanship due to PD explosions
25	.23	Faster reaction time under shock
31	.20*	Longer wt. disc. time under shock

*Highest loading

No clear pattern is evident in this factor. Taking cover frequently in CIC necessarily results in slow travel through the course.

SUMMARY

One major contribution of this analysis is the clear delineation of several factors in the domain of stress performance. That these factors do not in each case correspond with the given situation is important. Argument has been made that the high specificity of stress, the particularly individualistic element of the phenomena, precludes the finding of common factors. The evidence here indicates that some of the situations can be conceived as entities such as the oil fires as a group and the Dark Room, but the more complex problems, such as Combat-in-Cities, are so diverse in requirements

of performance that the measures derived are scattered over several factors.

A second important finding is the separation of indices of stress performance into three factors; namely, the cancelling of C's, the errors in the cancelling of C's and the eosinophils.

The third finding concerns the intelligence measures. In no instance do the intelligence measures correlate significantly with the various factors. Instead, they all appear in Factor A, which represents sheer intelligence, dissociated from stress performance.

The interpretations of the structure found in this factor analysis should not be considered as other than tentative until validation of the factors is effected. Replication of the study can only verify the invariance of the factor structure and would not constitute an evaluation of the meanings of the factors.

Chapter 4
EXTERNAL ANALYSIS I
RELATIONSHIP OF PERFORMANCE UNDER STRESS TO KOREAN DATA

LIFE HISTORY MATERIAL

Analysis of the life history material has two purposes in this study. The first is to examine the relationships between life history experiences (parental relationship, child training experiences, interests and activities) and performance in the stress situations. The second is to compare the pattern which emerges in relation to the findings in the Korean study where the description of the fighter was made in terms of identical life history material.

Subjects

The sample consisted of 110 subjects who completed all field test situations and the life history questionnaire. One hundred of these were Caucasian, nine were Negro, and one was Oriental.

Method

The subjects were given the Life History Inventory, a 100 item, multiple choice test, identical in form and content to the one used in the Korean study.

A stress index was developed, intended as a composite measure of performance in several widely differing stress situations.

This index was a sum of ten measures of performance under a variety of stressful conditions. These ten measures were chosen from a pool of forty-nine such measures (given in Table B-1, page 142 of Appendix B) on the basis of:

(1) The certainty with which good performance could be identified.

(2) Low intercorrelations of the measure, indicating the relative independence of the elements being measured.

(3) Representation of several conditions of stress, such as shock, dark, light, distraction, and fire. Since the shock performance scores were apparently independent, several were included to increase comprehensiveness of the composite score.

The actual scores which were used in assembling the stress index are listed below with the direction contributing to a high stress index score given in parenthesis.

(1) Change in the amount of time required to solve pencil mazes as the result of distraction (small)

(2) Jump Tower, latency time (short)

(3) Ratings in Dark Room performance (good)

(4) Percent decrease in accuracy of simple addition problems as the result of shock (small)

(5) Ratings on Open Tank Fire (good)

(6) Ratings on Boiler Room Fire (good)

(7) Percent decrease in speed of two-hand coordination as the result of shock (small)

(8) Percent change (regardless of direction) in time estimation as the result of shock (small)

(9) Percent decrease in hand tremor as the result of shock (large)

(10) Speed of reaction to the stationary dummy in the dark room (fast)

The intercorrelations among the ten variables scored as above are given in Table 21.

These ten measures were converted to T scores and summed to provide the stress index. A high score was defined as good performance and the sample was dichotomized at the median into effective performers (highs) and ineffective performers (lows), on the basis of the stress index. There were 55 high and 55 low performers.

Results

The nonsignificant correlation of ⁄.10 was found between the stress index and the Aptitude Area I (Intelligence) scores, and was not entirely in agreement with the results of the Korean phase of FIGHTER I. There, the correlation between good performance in combat and Aptitude Area I was ⁄.38 (inflated due to extreme groups, but probably representing a significant relationship). This disparity is most likely a function of the difference in intelligence levels between the entire group of Phase I subjects and the entire group of Phase II subjects. The mean AA-I score of the total group in Phase II is 102.22; the comparable mean for Phase I is 84.98, a difference which is significant at the .001 level ($t = 8.49$). Since the subjects in the two phases are not comparable in intelligence, the relationship between intelligence level and superior combat

Table 21

INTERCORRELATIONS OF STRESS VARIABLES COMPRISING THE A PRIORI STRESS INDEX

	1	2	3	4	5	6	7	8	9	10
1. Maze Performance										
2. Jump Tower Latency	.03									
3. Dark Room Rating	-.05	.12								
4. Shock Arithmetic	-.04	.24**	-.14							
5. Tank Fire Rating	.01	-.02	-.01	.00						
6. Boiler Room Rating	-.01	.13	-.17	-.01	.53*					
7. Shock-2 hand coord.	-.03	.16	.16	.06	.07	.04				
8. Shock-Time Estimation	.20**	.18	.00	-.02	.11	.02	-.03			
9. Shock - Tremor (hand)	.13	.00	-.23**	-.03	-.36*	-.28*	-.14	-.09		
10. Dark Room-Reaction Time	.01	.06	.35*	-.01	-.07	-.19	.10	-.04	-.07	

*Significance at .01
**Significance at .05

High stress index indicates effective performance. Variables are scored high in the direction contributing to a high stress index.

performance shown in Phase I, is not refuted by the Phase II data. It is possible for intelligence to be a more important factor in effective performance at lower levels of intelligence than at the higher levels where other factors can interact with intelligence.

The following items of information in the Life History Inventory are based on significant differences between the highs and the lows at the 1% or 5% levels of confidence. The highs were significantly more often the youngest child in the family. They stopped wetting the bed between the ages of three and five. They lived at home until entering the Army, as opposed to leaving home at an early age, and reported taking vacations before entering the Army.

The highs appeared to have had more financial experience than the lows, which may reflect higher economic status of family (their fathers more frequently belonged to country or athletic clubs), a greater need for money in order to finance their many activities and leisure time pursuits, or simply a more active and profitable use of their free time. For example, they earned more money at part-time jobs and in school, had borrowed more money from bank and loan companies, and more frequently had checking accounts.

With respect to the activity level of the highs, they reported less need for sleep in terms of hours per night than did the lows. They appeared to be a physically active and energetic group in view of the number and type of activities in which they participated. It appeared they much more often enjoyed bargaining, playing poker with the family, horse racing, football and basketball,

all of which reflect group activities or participation.

They also enjoyed dancing and "going on wild necking parties," which further represents a socially overt type of behavior. Among their other interests were playing musical instruments, going to movies, and reading such magazines as Time, Pic and Laff. More highs than lows checked the item "not particularly interested in politics."

The pattern which is observed for the low scorer, on the other hand, was one in which he was frequently the only child in the family, expressed little interest in active sports, and indicated no activity which the other group enjoyed. Lows described themselves as having drive, determination and will power. They attended the movies only about once a month, and politically considered themselves "middle of the roaders."

A comparison can be drawn between the patterns of interest and background which characterized the good performers in the stress situations, and the fighters who performed well in Korea. The differences which seem consistent for the fighters and the stress performers are worthwhile summarizing even though the number of items discriminating in both groups does not exceed chance in the formal sense.

(1) Fighters and highs had more financial experience. They made more money and spent more money than the nonfighters and lows. They more frequently had checking accounts and borrowed large sums of money, which suggests that their credit and contacts were better.

(2) The greatest correspondence of differences was found in the personal interest and activity of the fighters and highs. In Phase I, fighters emerged as "doers," and the nonfighters as "non-doers." In the current study, the highs had more varied interests which were, in turn, of a more active and masculine nature (sports, working on cars, playing poker). Nonfighters and low stress performers had fewer interests.

(3) Both fighters and highs participated in school sports and tended to prefer body contact activities. Mesomorphy was significantly related to both fighter status and good performance on the stress index (see Table 26, variable X_4). Reading tastes of the fighters and highs were somewhat similar in that both preferred magazines of a masculine nature.

In terms of financial or economic status, the "doer" pattern or syndrome, and masculinity (as specified), there appears to be some similarity in the pattern and background of fighters and highs.

FIGHTER TEST (IOQ)

The Interest Opinion Questionnaire (IOQ) was a personality questionnaire constructed from the items which best differentiated fighters from nonfighters in the Korean study. Two forms of the IOQ were administered, each with 150 items. These items were derived from published tests (the MMPI, 16PF, Strong VIB, and the IPAT Humor Test), and included selected Life History items. It was expected that the IOQ would display a relationship to quality of performance

in the various stress situations. As shown in the first column of Table 22 the magnitude of the correlations between the IOQ and performance in the stress situations is quite low. These correlations were based on Form A, administered during the first week of basic training, eight weeks before the stress experiment.

Since the fighter key based on the Korean data was computed from a total sample including many Negroes, a new key, a white key, was developed to eliminate this possible source of bioas. If the test were unduly bias by race, it would have little utility in the framework of this research in which 88% of the subjects were white. The new IOQ, based on the items best discriminating white fighters from white nonfighters, was applied to the white subjects in Phase II.

Comparisons of the findings with the two derived keys are given in Table 23. Only one change occurred among the six items which was significant: a negative relationship appeared between performance on Perimeter Defense and the IOQ, using the white key. This relationship did not exist when the old key was applied. The fact that the subjects with the high potential fighter scores performed more poorly on the Perimeter Defense situation is consistent with the results found in the following section where this situation is related to fighter traits derived from personality measures.

The correlation between Form A and Form B, of the IOQ, based on 102 subjects is $\neq .67$. In addition a correlation of $\neq .66$, (based on the same number of subjects) was found between the first administration of Form A, during the first week of basic training,

Table 22

CORRELATIONS BETWEEN STRESS SITUATIONS AND IOQ - Form A USING TOTAL SAMPLE KEY AND WHITE SAMPLE KEY FROM FIGHTER I

Stress Situation	IOQ Total Sample Key r	N	IOQ White Sample Key r	N
1. Combat-in-Cities	-.02	120	-.14	109
2. Jump Tower	.34*	124	.27*	113
3. Perimeter Defense	-.11	97	-.28*	80
4. Dark Room	.14	121	.14	110
5. Shock-Arithmetic	.10	125	-.06	114
6. Treasure Island Oil Fires	.10	121	.05	110

*Significant at .01 level

and the re-administration of Form A during the testing week two months later. The estimated reliability (Spearman-Brown) of the IOQ for Form A and B combined is $\neq$.80.

FIGHTER TRAITS

FIGHTER I summarized the host of differences that appeared between fighters and nonfighters in the Korean study of combat infantrymen in terms of eleven different personality traits. A sufficient number of identical measures was used in the current analysis to permit computation of estimates for nine of the eleven traits. (See Table 23) The purpose of this analysis was to examine the usefulness of these nine traits in discriminating between the good and poor stress performers. If a clear demarcation were obtained between the trait profiles of the good performers as compared to the poor performers, our confidence in the value of the stress situations as combat substitutes would be considerably enhanced. Such a similarity would argue common determiners of the performance level of the individuals in two different circumstances. An additional advantage of this kind of analysis is the promise it has for differentially evaluating each stress situation with respect to the findings obtained in the Korean study. For each trait the constituent variables which discriminated in the total group in FIGHTER I were converted to standard scores and averaged since the number of variables used for each trait was not the same. The data were then analyzed by making a separate analysis of variance for each of the stress situations and the composite stress index. The mean scores are shown graphically for the various stress situations in Figure 2.

Table 23

TESTS USED FOR ESTIMATING FIGHTER TRAITS

(derived from analysis of total group in FIGHTER I)

Fighter Trait	Measure
1. Intelligence	Aptitude Area I
2. Masculinity	Mesomorphy Ectomorphy (minus) CPI – Feminity (minus)
3. "Doer"	Life History Inventory* Item 66 A – E) Sum of 39 " 67 A – E) sports, " 68 A – E) hobbies " 73 A – E) and " 74 A – E) activities IOQ Form A*) Item 146 A – E) IOQ Form B*) Item 149 A – E) Item 150 A – E)
4. Emotional Stability	16PF Factor C – Emot. Stab. CPI Dissimulation (minus) CPI Infrequency (minus) Guilford-Zimmerman ** Temperment Survey E score
5. Home Stability	Life History Inventory* Item 1 A (minus) Item 9 D Item 24 A (minus) Item 64 B IOQ Form A* Item 142 C (minus) IOQ Form B* Item 148 B
6. Tolerance and Social Responsibility	CPI: Responsibility Tolerance
7. Preference by Peers	Sociometric Ratings*(minus) Item 3 – combat
8. Military Knowledge	Military Information Test* Tactics Weapons
9. Speed and Accuracy	Decision Time (Social Evaluations)* One Hand Tapping Two Hand Coordination Fast Reaction Time*

* The sources for these tests are given in Appendix D
** Not given in FIGHTER I; used as substitute here.

Figure 2

MEAN STANDARD SCORES ON ESTIMATED FIGHTER TRAITS
OF GOOD AND POOR STRESS PERFORMERS

		Intelligence	Masculinity	Doer Syndrome	Emotional Stability	Home Stability
Dark Room	good	51.7	51.2	52.6	50.7	49.2
	poor	50.9	49.6	49.6	50.2	51.1
Combat-in-Cities	good	50.2	51.3	49.5	49.8	49.2
	poor	52.3	49.5	52.8	51.4	50.2
Perimeter Defense	good	46.6	50.8	47.8	49.1	49.2
	poor	53.7	50.6	52.6	52.0	48.3
Jump Tower	good	51.4	51.7	53.0	50.7	49.9
	poor	50.6	49.1	48.2	50.3	49.6
Shock-Arithmetic	good	49.8	50.4	49.2	49.3	48.9
	poor	52.5	50.7	52.8	51.6	50.7
Boiler Room Fire	good	50.5	51.9	50.6	50.4	49.4
	poor	51.6	49.5	51.1	50.8	50.4
Open Tank Fire	good	49.5	51.0	51.0	50.2	49.8
	poor	52.7	50.0	50.9	50.7	50.0
Combined Firefighting	good	49.9	52.0	51.3	50.3	50.7
	poor	52.2	49.4	50.4	50.8	49.4
Stress Index	good	50.5	50.8	52.1	50.9	48.4
	poor	51.6	50.2	50.0	50.0	51.2

MEAN STANDARD SCORES ON ESTIMATED FIGHTER TRAITS
OF GOOD AND POOR STRESS PERFORMERS (cont'd.)

		Tolerance and Social Responsibility	Preference by Peers	Military Information	Speed and Accuracy
Dark Room	good	50.4	51.4	51.9	50.6
	poor	50.1	50.2	51.1	50.4
Combat-in-Cities	good	51.5	51.5	50.3	50.0
	poor	49.3	50.3	53.1	51.3
Perimeter Defense	good	50.0	52.4	46.7	47.8
	poor	50.7	50.0	54.0	51.8
Jump Tower	good	51.0	51.5	52.0	51.2
	poor	49.6	50.0	50.7	49.2
Shock-Arithmetic	good	49.4	50.7	51.0	49.7
	poor	51.0	50.9	52.3	50.8
Boiler Room Fire	good	50.4	51.8	50.8	50.2
	poor	51.0	49.8	52.1	50.8
Open Tank Fire	good	50.6	52.6	51.1	50.0
	poor	49.9	49.0	52.1	50.6
Combined Firefighting	good	51.4	53.2	50.5	50.6
	poor	50.0	48.5	52.3	50.4
Stress Index	good	51.8	51.9	51.6	50.4
	poor	48.9	49.8	51.5	50.4

The final version of this report as printed by photo-offset methods will contain a chart on this page based on the values here given on this and the preceeding page.

The only instance where the good and poor performers on a stress situation differed significantly over all nine traits occurred in the Perimeter Defense situation. However, as shown in Table 24, the value of this finding appears to be nullified by the presence of a significant interaction term associated with the Perimeter Defense situation. Our confidence in the validity of any stress situation would have been enhanced, had a significant difference in the traits of good and poor performers appeared together with no interaction effect -- a complete separation of the high and low groups in terms of all nine traits.

Two of the patterns are noteworthy in that no inversion occurred. The direction of the difference was consistent among all nine traits, for the Jump Tower and Shock-Arithmetic situations. If the magnitude of the differences is ignored and attention paid only to the direction of difference, the two-tailed probability of such a pattern emerging is of the order 2^{-8}. Although the superior Jump Tower performers tended to score higher on all nine traits, the reverse is true for Shock-Arithmetic, where the superior performers tended to score lower. A suggestion which further research would do well not to ignore is that the requirements for performance in the situations involving physical effort (e.g. Jump Tower) may be quite unrelated to performance in situations requiring cognitive effort under duress (e.g. Shock-Arithmetic).

Table 24

SUMMARY OF ANALYSES OF VARIANCE OF FIGHTER TRAIT SCORES FOR GROUPS DICHOTOMIZED BY PERFORMANCE LEVEL IN EACH STRESS SITUATION

Situation	Level of Significance	
	Between Means of Traits of Hi and Lo Performers-	Interaction of Means for Traits and Performance
1. "Treasure Island Oil Fires"		*
2. Perimeter Defense	*	**
3. Dark Room		**
4. Combat-in-Cities		*
5. Jump Tower		
6. Shock Arithmetic		
7. Stress Index		

* = .05
** = .01 or less

Chapter 5
EXTERNAL ANALYSIS II
INFLUENCE OF A PARTNER ON STRESS TOLERANCE[1]

Several observers have reported on social influences on performance under stress and the ability to tolerate stress. Marshall,[2] for example, has noted that the quality of individual performance under actual combat stress can vary greatly, depending on such morale factors as a man's physical and social contacts with other men of the unit. With one exception, the testing circumstances did not permit observation of the effect on a subject of witnessing another subject's performance. The stress tests were located at widely distant points. When each man was taxied out for testing he had not seen the situation before, nor heard anything about it. Several subjects were present simultaneously during the Navy fire tests, but because of the complexity of the situation it was not considered feasible to measure social influences. A planned exception to the typically isolated manner in which the subjects were tested occurred immediately following the Shock-Arithmetic problem.

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[1]This chapter is a summary of a detailed report which will be found in Appendix C.

[2]See reference 17.

This experiment was designed to compare the difference in tolerance to electric shock when subjects were tested alone and when they were tested in the presence of another subject who apparently also received an electric shock.

METHOD

Two determinations of tolerance to electric shock were made for each subject with the apparatus described in Appendix C. In one, the subject was alone with the experimenter; in the other, the subject believed that a partner was also in the circuit. For both determinations the subject himself increased the amperage to the highest level he felt he could tolerate. His instructions were to move his hand from the current control when he reached this level. This was the signal for the experimenter to interrupt the charge.

For the condition involving a partner, the subject was told that another subject, who had been brought in and seated next to him, would simultaneously receive shock of exactly the same intensity. However, the partner received no shock although electrodes were also attached to his leg. Since the subjects were tested successively, the experimental arrangement permitted us to employ each subject as an unwitting accomplice during the testing of the next subject. From twenty to thirty subjects were tested each week for a period of six weeks. During the first three weeks, the testing order was "shock alone," followed by "shock with partner." Testing order was reversed during the second three weeks.

RESULTS

Differences between (a) the two shock conditions, (b) the two presentation orders, and (c) the six successive weeks of experimenting, were tested for significance by an analysis of variance. A summary of this analysis is given in Table 25.

When the differences between the shock alone, and shock with partner conditions were tested by the alternative error terms, Fs of 31.28 and 30.85 were found, indicating that the mean differences were significant beyond the .001 point. The mean current setting for the shock alone was 3.13, while the mean setting for the shock with partner was 3.58. The difference between the two presentation orders was not significant, F being less than 1.00. Consequently, there is no reason to think that presentation order had any bearing on the results of the two shock conditions. This conclusion is substantiated by the nonsignificant condition-by-presentation-order-interaction. Here, also, F was less than 1.00.

When the overall differences among the six weeks of experimenting were tested, an F of 2.30 was found, showing that the weeks differed significantly at the .05 point. The mean current setting during the six weeks ranged from 2.66 in the first week, to 4.12 in the second week. However, since the condition-by-week-interaction proved nonsignificant with an F less than 1.00, the differences among weeks plainly had no effect on the differences observed under the two shock conditions.

Table 25

ANALYSIS OF VARIANCE: INTENSITY OF ELECTRIC SHOCK FOR TWO EXPERIMENTAL CONDITIONS, TWO PRESENTATION ORDERS AND SIX WEEKS OF TESTING

Source	df	MS	F
Orders	1	21202.54	———
S/Orders	131	40757.09	
Weeks	5	89018.19	2.30*
S/Weeks	127	38703.08	
Total Between Ss	132		
Conditions	1	133315.88	31.28**
Conditions x Orders	1	4227.30	———
S/Orders x Conditions	131	4261.56	
Conditions	1	133315.88	30.85**
Conditions x Weeks	5	2740.30	———
S/Weeks x Conditions	127	4321.18	
Total Within Sx	133		
Total	265		

* P = .05.
** P = .01 or less.

DISCUSSION

Under these experimental conditions, the presence of a partner acted to raise the subject's tolerance level for electric shock significantly beyond the level yielded when the subject was tested alone. A point of no small interest is the fact that the partner received no shock while the subject under observation shocked himself. To the best of our knowledge the partner did not learn that he would not be shocked until the trial was essentially concluded. Apparently, the change in stress tolerance was mainly a result of a relationship perceived by the subject between himself and the partner which did not, in fact, exist. Confirmation of this point awaits further research in which the shock with a partner condition reported here may be compared with a new condition in which a partner actually does receive an electric shock.

These results may be interpreted in several ways. On the one hand, the presence of a partner in a stressful situation might act to raise shock tolerance by producing competitive behavior; on the other hand, a partner may provide reassurance of the ability to tolerate stress. Davitz and Mason[1] suggest a balance between competitive drive states as the explanation for their results, with the introduction of a partner tending to reduce the fear drive by creating a sort of disinhibiting distraction.

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[1] See reference 11.

Chapter 6
EXTERNAL ANALYSIS III
MULTIPLE REGRESSION ANALYSIS OF THE STRESS SITUATIONS

PURPOSE

A multiple regression analysis of the stress situations was carried out to determine how much of the variance of each stress performance could be accounted for by personality variables, and to examine how well predicted scores based on the regression equations would identify the known fighters and nonfighters in the previous study.[1]

METHOD

The correlations between the six stress situations and a set of 89 questionnaire and test scores were examined for potential predictor variables. Six common variables were selected for use in the regression equations for all six stress situations. Since the same group of predictor variables were used in every equation two desirable ends were attained. In addition to making the equations directly comparable, the maximal shrinkage associated with use of only the highest correlations was avoided, since some

[1] The Small Oil Fire was not included in this analysis.

low correlations were necessarily included.

To achieve fairly an optimal multiple R, it is necessary that the predictor variables have minimum intercorrelations. Selection of the six predictor variables was aided in part by examining the range of intercorrelations contained in FIGHTER I data analyses. The full list of correlations is given in Appendix D. A summary of the correlations among the predictor variables selected and the stress situations is given in Table 26.

It should be noted that while the original list of 89 potential predictors was limited to only those tests that showed a significant difference between fighters and nonfighters in the Korean study, the selection from these for the regression was based entirely on correlations in the present study.

RESULTS

The range of predictor variable intercorrelations (from which the multiple R's are computed) is from -.06 to .42. The criterion intercorrelations ranged from -.23 to .26. The range of correlations between individual predictor variables and the criterion stress situations was from -.30 for Perimeter Defense and Policeman (SVIB) to .31 for Dark Room and Social Status (CPI).

The results of the multiple regression analysis are summarized in Table 27. The multiple R's range from .20 to .47 with only Shock Arithmetic falling below .39. The Beta weights are those derived from correlations in this study. These weights in turn were applied to the written test scores to derive predicted criterion

Table 26

PRODUCT MOMENT INTERCORRELATIONS OF CRITERION STRESS SITUATIONS AND SELECTED PREDICTOR VARIABLES (N = 49 to 113)

Predictor Variable	X_1	X_2	X_3	X_4	X_5	X_6	1	2	3	4	5	6
X_1 CPI Social Status												
X_2 Ponderous Humor (Factor 8)	-.06											
X_3 Sophistication (16 PF Factor)	.16	-.01										
X_4 Mesomorphy	.34	-.12	.11									
X_5 Combat Peer Ratings(Sociometric)	.20	.00	.20	.42								
X_6 Policeman (SVIB)	-.04	.01	.23	.14	.17							
Criterion												
1 Dark Room	.31	.11	.24	.28	.19	.13						
2 Oil Fire Fighting	.08	.17	-.06	.18	.28	-.19	-.14					
3 Combat-in-Cities	-.09	.12	-.09	.21	-.08	.28	.05	.05				
4 Jump Tower	.29	.16	.07	.24	.16	-.05	-.11	-.12	.01			
5 Perimeter Defense	.01	.25	-.19	.12	.04	-.30	-.09	.26	.25	-.11		
6 Shock-Arithmetic	.07	.13	-.07	-.07	-.04	-.11	-.13	.15	.13	-.23	.10	

Table 27

MULTIPLE REGRESSION EQUATIONS FOR PREDICTING THE STRESS SITUATIONS

Criterion		R
1. Dark Room	$.228X_1 + .151X_2 + .166X_3 + .182X_4 + .020X_5 + .075X_6$	.438
2. Oil Fire Fighing	$-.010X_1 + .184X_2 - .070X_3 + .133X_4 + .278X_5 - .240X_6$	.425
3. Combat-in-Cities	$-.117X_1 + .153X_2 - .133X_3 + .339X_4 - .221X_5 + .295X_6$	.462
4. Jump Tower	$.223X_1 + .192X_2 + .020X_3 + .170X_4 + .058X_5 - .080X_6$	.387
5. Perimeter Defense	$-.041X_1 + .279X_2 - .145X_3 + .212X_4 + .041X_5 - .304X_6$	.466
6. Shock-Arithmetic	$.106X_1 + .130X_2 - .053X_3 - .063X_4 - .012X_5 - .082X_6$	.203

Where:

X_1 = CPI Social Status
X_2 = Ponderous Humor (Factor 8)
X_3 = Sophistication (16 PF Factor N)
X_4 = Mesomorphy
X_5 = Combat Peer Ratings (Sociometric)
X_6 = Policeman (SVIB)

scores whose intercorrelations are given in Table 29. In addition, the same Beta weights were applied to the fighters and nonfighters in the Korean study. (The same written tests were used in both studies.) The group means and differences on the predicted criterion scores are shown in Table 28. Fighters scored significantly higher than nonfighters in the Dark Room and Jump Tower situations. Although the four remaining situations failed to show a significant difference, nonfighters scored higher in Combat-in-Cities, Shock-Arithmetic, and Perimeter Defense and scored lower for Oil Fire Fighting.

An equivalence between the requirements for combat and for the present stress situations cannot be satisfactorily established. From the regression equations using the six predictor tests described above, the lack of consistency of direction of results makes it impossible to specify elements which are common to the two circumstances.

The highest correlation obtained between predicted scores was .89 for Dark Room and Jump Tower with an N of 106. In the Korean study, which had as its major concern identification of the characteristics which differentiated combat fighters from nonfighters, the correlation between these predicted scores was .82, based on 197 cases. The next highest predicted-score correlation was .80 between Oil Fire Fighting and Perimeter Defense. For the Korean study the predicted scores for these situations correlated .83. This remarkable consistency is evidenced throughout the two studies with the difference between correlation coefficients of the two samples being no greater than .07 except in the single case of the Oil Fire Fighting and Dark Room situations where the difference is .15.

Table 28

SIGNIFICANCE OF THE DIFFERENCE OF PREDICTED STRESS PERFORMANCE SCORES FOR FIGHTERS AND NONFIGHTERS IN EARLIER KOREAN STUDY

Situation	Group	M	σ	t	P
1. Dark Room	Fighters	41.88	3.48	3.94	<.01
	Nonfighters	39.55	4.12		
2. Oil Fire Fighting	Fighters	13.85	4.53	.83	NS
	Nonfighters	13.27	4.63		
3. Combat-in-Cities	Fighters	15.60	5.18	.38	NS
	Nonfighters	15.89	5.00		
4. Jump Tower	Fighters	29.61	3.36	2.82	<.01
	Nonfighters	28.03	3.88		
5. Perimeter Defense	Fighters	1.60	5.00	1.23	NS
	Nonfighters	2.64	5.92		
6. Shock-Arithmetic	Fighters	1.19	1.99	.84	NS
	Nonfighters	1.44	1.95		

Table 29

INTERCORRELATIONS OF PREDICTED CRITERION SCORES

	1.Dark Room	2.Oil Fire Fighting	3.Combat-in-Cities	4.Jump Tower	5.Perimeter Defense
1. Dark Room					
2. Oil Fire Fighting	.383				
3. Combat-in-Cities	.200	-.045			
4. Jump Tower	.887	.665	.145		
5. Perimeter Defense	.109	.796	.254	.573	
6. Shock-Arithmetic	.154	.321	-.170	.445	.597

As a result of the generally high predicted criterion intercorrelations, the written tests reveal a common factor operating in all of the six criterion measures. However, there are specific factors within each stress situation that are unaccounted for. These specific factors contaminate the performance scores and cause low actual criterion intercorrelations. If this is the case then further research is needed to discover the factors which are specific to each stress situation. Allowances can be made for having emphasized low written-test intercorrelations rather than attempting to increase the relationship between the written tests and the criterion.

Among the many potential predictor variables unexamined in the present study a few may possibly be found that would permit the derivation of a multiple R sufficiently high in validity that the reapplication of the formulae to the Korean sample would result in a practical separation of the fighters and nonfighters. Since the fighter and nonfighter groups in the earlier study represented extremes on a continuum, the predictability of fighter performance must accordingly satisfy more rigorous demands than would be acceptable had the full distribution of fighter behavior been present.

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Appendix A
DETAILED DESCRIPTION OF THE STRESS SITUATIONS

The following accounts contain a brief description of the situations and the exact instructions used.

JUMP TOWER

Procedure

When the subject arrives at the course, Examiner 1 will take a reading of his pulse beat for 30 seconds. The subject is then told, "You are to climb to the top of this tower and when you reach the top, you will be given further instructions." The subject will be scored by Examiners 2 and 3 for the amount of time he takes to climb the tower.

Upon reaching the platform of the tower, Examiners 2 and 3 will fasten the subject into the parachute harness. They do not speak to him until he is fastened in securely and the brake is handed to him. When this is done, Examiner 2 says,

"You are to jump off the platform and move down the cable as quickly as you can, the faster you move the higher your score. The rope you are holding is a brake and it will slow you down a little or a great deal depending on how hard you pull it. Since the object of this test is to move down the cable quickly,

do not pull on the brake unless you are frightened for this would lower your score.

"Right now you are being held in place by a safety device. When we release this device the only thing that will hold you up here until you are ready to jump is the brake you are now holding. Since the carriage weighs 70 pounds, you will have to put a great deal of pressure into holding yourself in check. Put your toes against this cleat (Examiner sees that subject follows instructions) and hold the brake tightly from now on until you jump (make sure the subject is applying enough pressure to the brake to hold himself in place).

"When the device is released, you will be told to move very slowly up to the first cleat. You are not to jump until you are instructed: 'Jump when you are ready.' That means to jump whenever you feel you are ready after that.

"Jump so that you clear the side of the platform. If you were jumping from a plane, you would want to clear the fuselage - the same principle applies here. When you reach the low point, that is, the closest frame to us, lift your feet so that you don't drag them along the ground. Do you have any questions?"

Examiner 2 will score the subject on the total number of questions asked. In addition, he breaks down the number of questions asked into

the following categories: questions about danger, questions about the mechanism and miscellaneous questions.

The door is then opened and the safety mechanism released. Examiner 2 says, "Move slowly forward to the first cleat." When the subject has been standing at the edge for 3 seconds, Examiner 2 says, "Jump when you are ready." The subject is scored by Examiners 2 and 3 on: (1) The latency between the time he received the instruction and when he actually jumped, (2) The time required for the subject to reach the low point (before rebound). (3) Signs of fear, etc.

When the subject reaches the bottom, Examiner 1 will move in the portable platform, release the subject from the harness, take his pulse beat reading for 30 seconds, give the subject Cancelling Cs for another 30 seconds and then tell him to wait at the road for the vehicle which will take him to his next station.

Subject is cautioned not to talk about the tower to any of the other subjects until all 30 have been tested.

Finally an over-all rating on the subject on a 7-point scale (1 being highest and 7 lowest) will be entered for each subject. Each of the three examiners will make an independent rating of the subject. They are not to discuss their ratings among themselves.

The seven categories are as follows:

(1) No hesitation, overt fear, etc. - excellent overall performance.

(2) No overt fear, very little hesitation- very good overall performance.

(3) No overt fear, somewhat hesitant - good performance.

(4) Rather hesitant - fair overall performance.

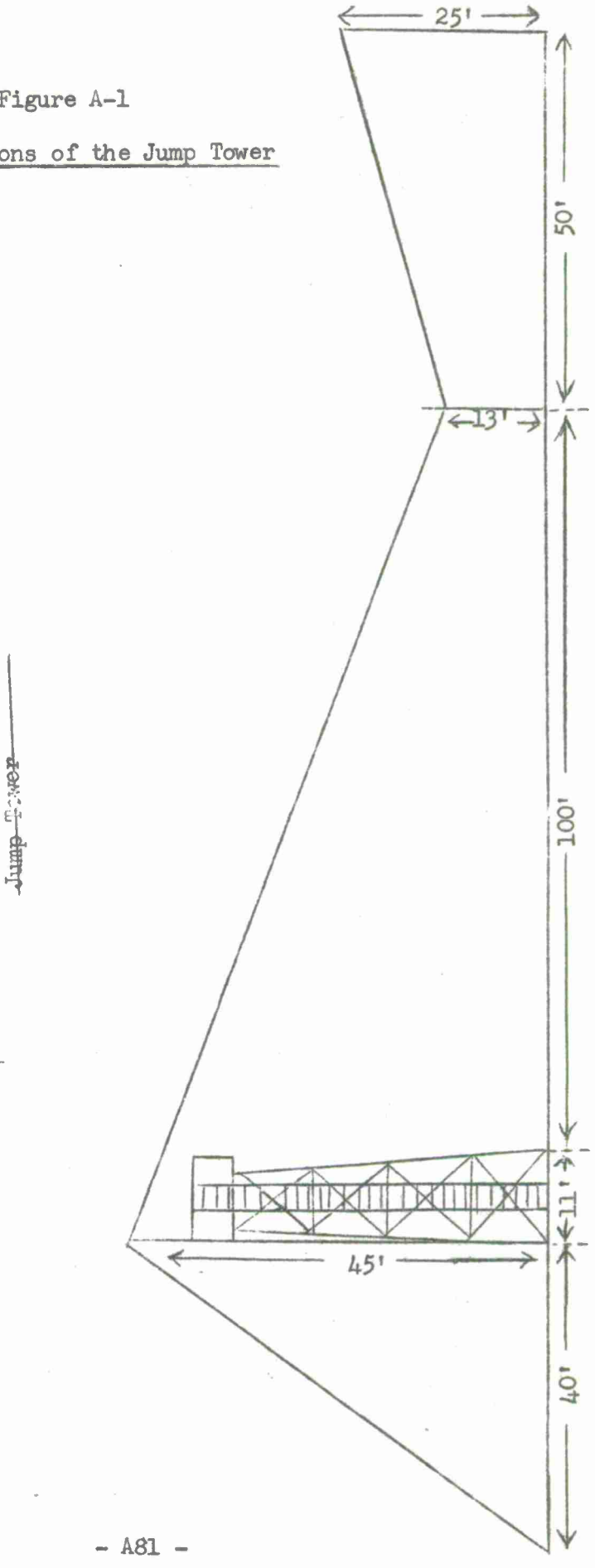
(5) Some signes of fear, hesitant - poor overall performance.

(6) A great deal of fear, much hesitation - very poor overall performance.

(7) Subject froze - he did not jump. (Subject was given 180 seconds in which to jump. However, none of the subjects who actually jumped took longer than 35 seconds to jump.)

Figure A-1

Specifications of the Jump Tower



THE DARKROOM

General Description

This situational test took place in an almost completely darkened barracks. The subjects were given instructions to bayonet dummies they saw in the room as though they were live, enemy soldiers.

The subjects followed a luminous path in the darkness. They were first met by a screaming dummy which swung into them head on; then they were attacked by another screaming dummy which came into them from behind and slightly to the right; then the path led near a stationary dummy with a skull-like face. This was suddenly illuminated and began shouting "Get him, get him, get him."

Ratings were made for each encounter as well as for the overall performance of the subjects. Pulse was taken - and the Cancelling C's test was given immediately afterwards.

In the following pages the procedures and equipment are described in detail. The description will often refer to the diagram of the Dark Room (**Figure A-3**).

Procedure

The subjects were sent, one every 10 or 12 minutes, to Bldg. 1209 from the testing room. When the subject arrives, an assistant outside puts a blindfold over his eyes and has him wait two buildings away. When the tester is ready, the assistant leads the blindfolded subject inside the darkened hallway of #1209, tells him to close his eyes while the blindfold is removed,

and the assistant leaves to wait for the next subject.

A second assistant inside the hallway tells subject to open his eyes, put on a luminou-painted helmet liner, put his bayonet on his rifle, and put a luminous scabbard over the bayonet. The inside assistant steps around a canvas curtain into the barracks proper, and signals the tester that subject is ready.

The tester reads the instructions through the canvas:

"You are going to walk through a very dark room. On the floor of this room is a path that you'll be able to see in the dark. Follow this path, walk slowly, and keep alert.

"There are dummy figures inside the room. As soon as you see a dummy, bayonet it as though it's a live, enemy soldier. You are to bayonet the dummies; don't use butt strokes. The dummies are easy to see, so don't swing at things in the dark. After each dummy, keep on the path to a square on the floor. Stop and wait on this square until told to go again. Are there any questions?"

The tester then leaves to operate the dummies; and the assistant leads subject into the barracks proper, asks if he can see the path. If he can, he is told, "Go ahead." If he cannot, he is told to wait until he can before moving. The assistant points out the individual dots with a luminous pointer, if necessary. When subject is able to see the path, he is told "Go ahead."

The assistant moves ahead to a point where he will be

able to see the encounter with the first dummy.

When the subject (visible with his luminous helmet and scabbard) reaches X_1 on the diagram, the tester pushes dummy #1 around directly into the subject. When the dummy is about eight feet from subject (luminous marks are on the beam and opposite wall), the tester turns on a loud tape recorded scream and a dim light mounted on the beam illuminating the dummy.

After the lights go out again, subject, ordinarily proceeds to the square and waits there. If he does not, the assistant tells him to "Go ahead to the square."

When subject has stopped in the square, the tester and the assistant make their ratings (see form); and the tester swings the beam in position for dummy #2, readjusts the tape recorder, and gets in position.

When finished, he signals the assistant with a small flashlight; and the assistant says "Go ahead."

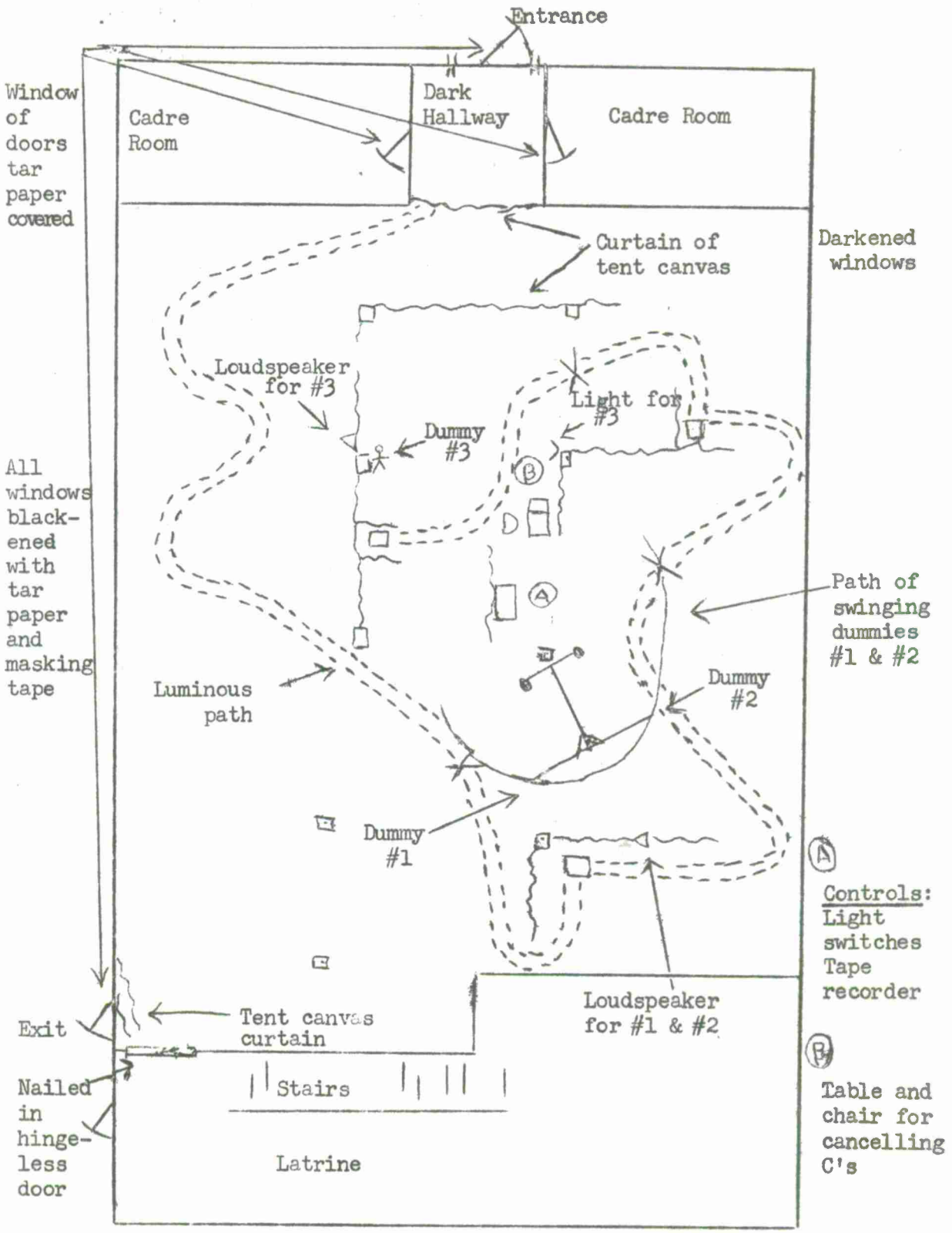
When subject gets to X_2, the tester pushes the beam around for dummy #2 to attack the man from behind, turns on the scream and a dim light when the dummy is about ten feet behind subject.

Subject goes or is directed to the next square as before. The assistant and tester make ratings, they both set their stopwatches, and the tester resets the tape recorder and loudspeaker plugs for dummy #3. As before, subject is told "Go ahead."

When subject reaches X_3, the tester simultaneously

Figure A-2

Overall Diagram of the Darkroom



Bldg. #1209 - Lower floor

turns a dim light on stationary dummy #3, turns on a voice speaking from the dummy ("get him, Get Him, GET HIM," etc. - louder each time). He and the assistant time the reaction. When subject bayonets the dummy, the lights and sound go out; and subject goes to the last square. Tester and assistant complete their ratings before turning the lights on.

The assistant goes out to get the next man, and brings in subject's helmet.

The tester turns on the lights and says: "Lay your rifle down on the floor. Let me take your pulse (15 secs). Sit down in the chair. Cross out the C's (30 secs), Stop." He then takes and signs the man's card and has the man put his name and number on the sheet for crossing out C's. The assistant returns with the man's helmet, and collects the luminous scabbard and liner to give to the next man.

The experimenter directs subject to the door and asks him not to tell the other subjects about this test until the day's testing is done.

Figure A-4

DARKROOM RATING FORM

Name_____ Order_____

No._____ Rater_____

1. A. Movement before contact:
   - __1 Moved forward
   - __2 Stood his ground
   - __3 Moved back or to the side, then stood his ground
   - __4 Still moving back at contact
   - __5 Moved out of path of dummy

   B. Kind of contact:
   - __1 Bayonets body, neck or head
   - __2 Bayonets arm or leg
   - __3 Blocks with rifle
   - __4 Blocks with body
   - __5 No contact

   C. Stength of contact:
   - __1 Strong thrust
   - __2 Weak thrust
   - __3 Waited for dummy to make contact
   - __4 Moving back at contact
   - __5 No contact

2. A. Movement before contact:
   - __1 Turned around and moved forward
   - __2 Turned around and stood his ground
   - __3 Froze, with back to dummy
   - __4 Kept walking forward until hit by dummy
   - __5 Moved forward out of path of dummy

   B. Kind of contact:
   - __1 Bayonets body, neck or head
   - __2 Bayonets arm or leg
   - __3 Blocks with rifle
   - __4 Blocks with body
   - __5 No contact

   C. Strength of contact:
   - __1 Strong thrust
   - __2 Weak thrust
   - __3 Waited for dummy to make contact
   - __4 Moving back at contact
   - __5 No contact

3. A. Initial movement when light turned on:
   - __1 Moved backward
   - __2 Froze
   - __3 Moved forward immediately

   B. Strength of contact:
   - __1 Strong thrust-slammed dummy against wall
   - __2 Average thrust
   - __3 Weak or token thrust
   - __4 No contact

   C. Reaction Time from light to contact:_____sec.

4. A. Movement before contact:
   - __1 Moved forward
   - __2 Stood his ground
   - __3 Moved back or to the side, then stood his ground
   - __4 Still moving back at contact
   - __5 Moved out of path of dummy

   B. Kind of contact:
   - __1 Bayonets body, neck or head
   - __2 Bayonets arm or leg
   - __3 Blocks with rifle
   - __4 Blocks with body
   - __5 No contact

   C. Strength of contact:
   - __1 Strong thrust
   - __2 Weak thrust
   - __3 Waited for dummy to make contact
   - __4 Moving back at contact
   - __5 No contact

5. Overall rating of subject's performance
   - __1 Completely effective in this situation
   - __2 Effective, but somewhat hesitant
   - __3 Average reaction
   - __4 Ineffective, but not complete failure
   - __5 Completely ineffective response to situation

6. Pulse rate just afterwards _____/min.

Figure A-3

Detail of Swinging Dummies #1 and #2

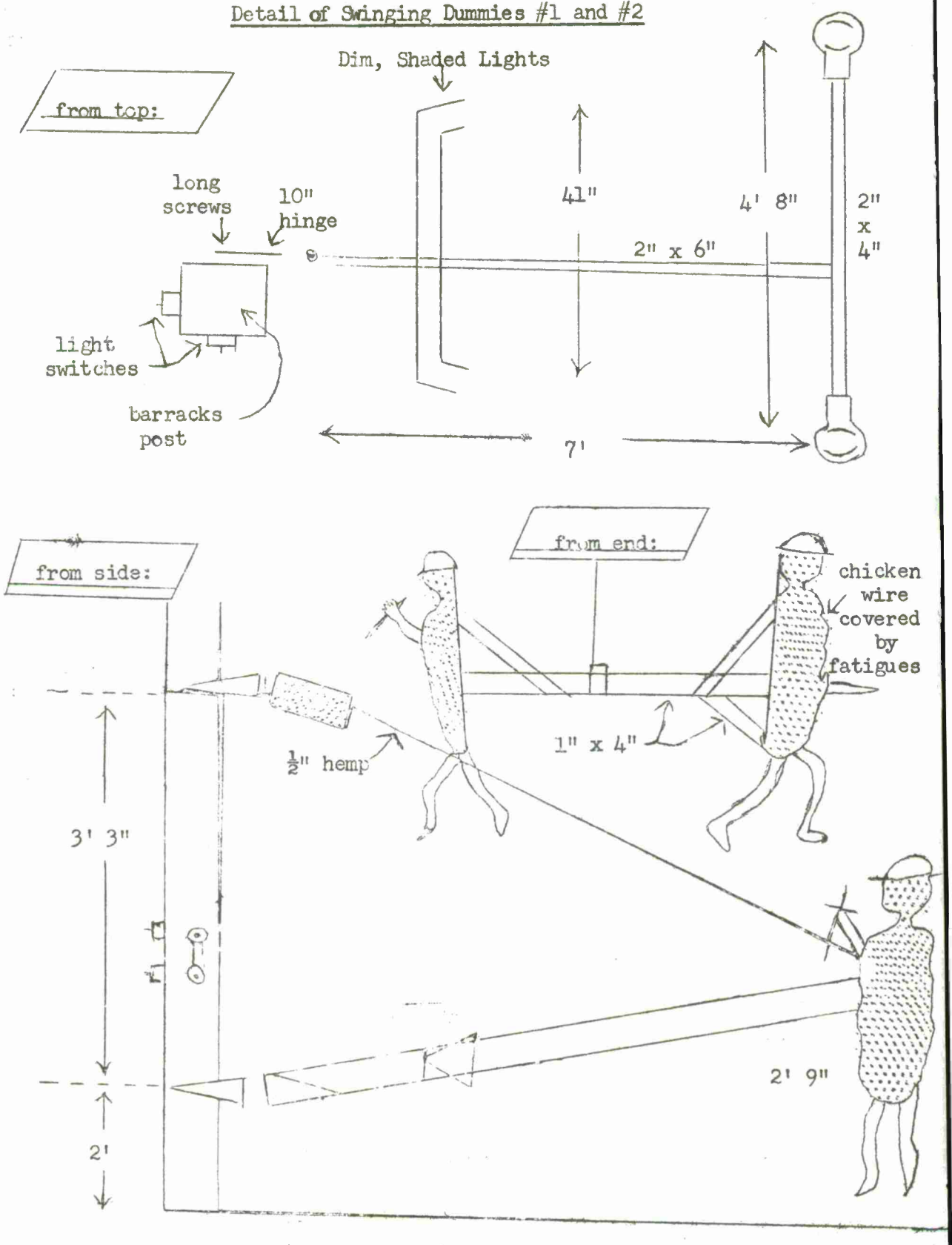
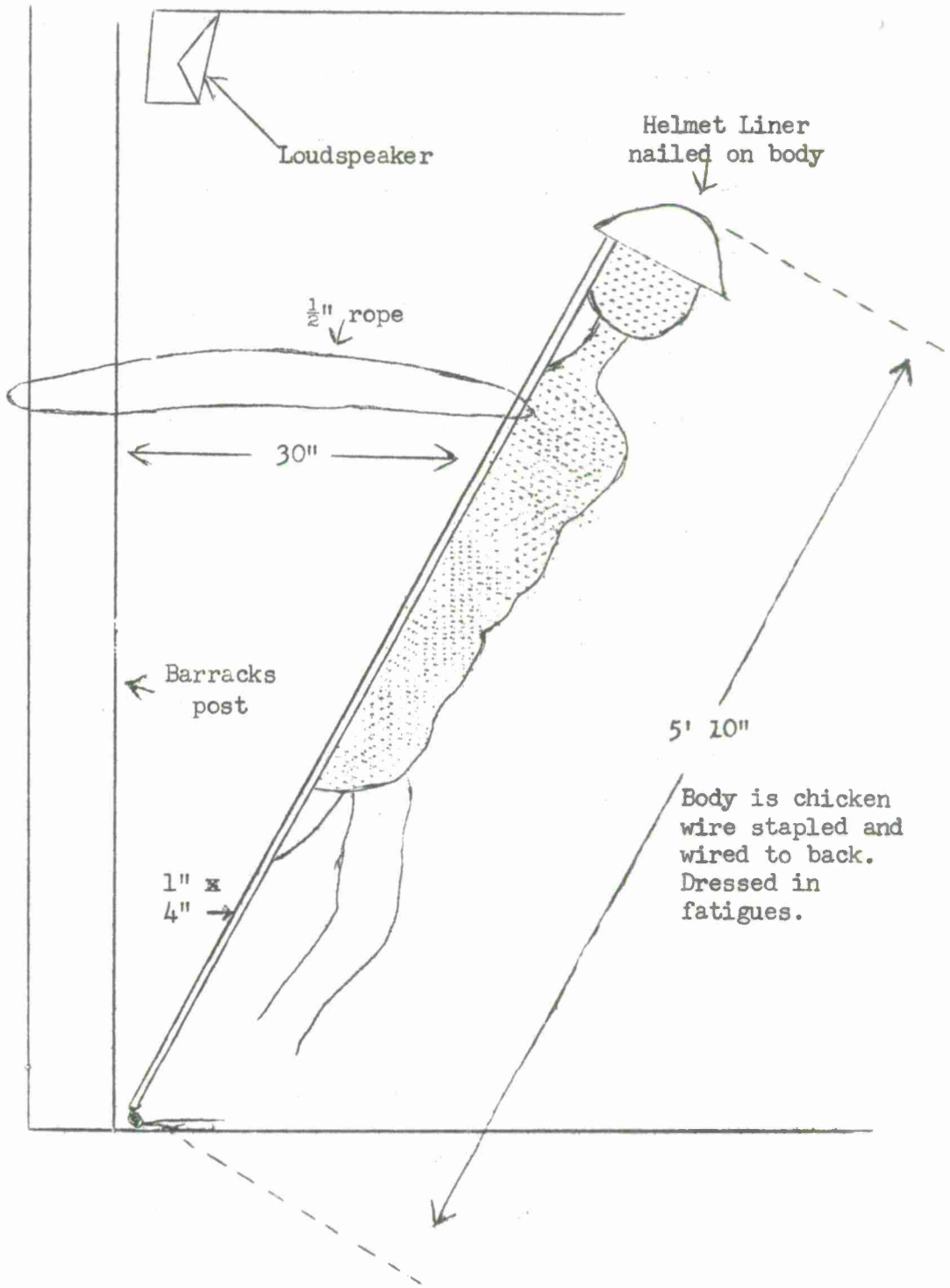


Figure A-4

Figure of Stationary Dummy #3



COMBAT-IN-CITIES

General Description

We used Combat-in-Cities course #1 with some modification. In place of the pull-up targets, we used six "Punch Petes" an electrically powered, solenoid operated, pop-up targets developed by Human Research Unit #3, Fort Benning, Georgia. After a short briefing by the officer in charge concerning the mission, the subject followed a course through the city accompanied by explosions and pop-up targets. Each subject was run singly; although the time through the course ranged from one to eight minutes, preparations and repairs limited the flow to five per hour optimably.

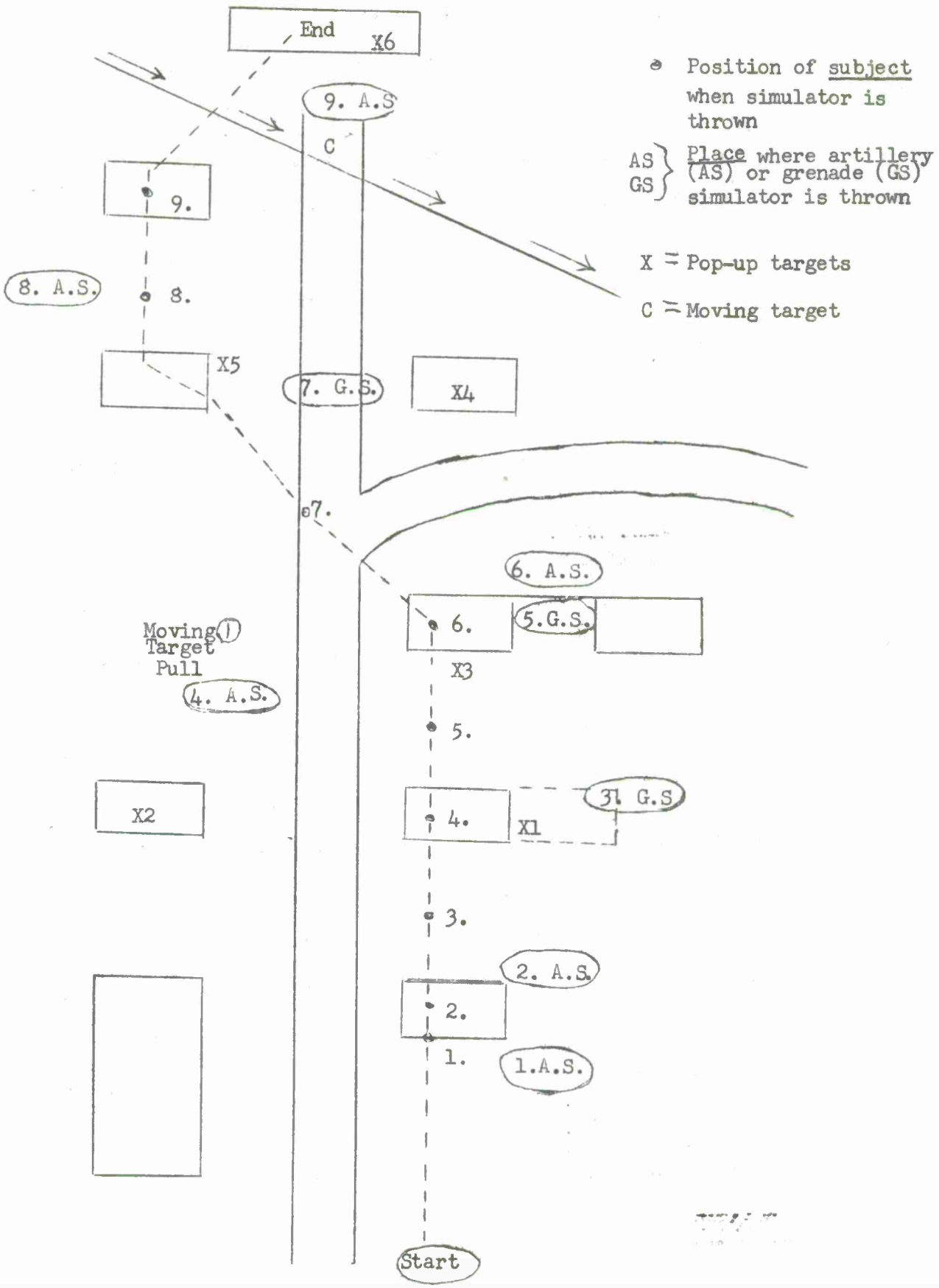
Procedure

When the subject arrives at the starting point, he is given two clips of ammo for his cartridge belt. The safety officer (lieutenant or CWO) says:

"Your problem here is to join your company on the other side of the village you see before you, that is, on the other side of that far building. (Point) Do you see it? To get there, you must pass through the village where it is thought there might be enemy. Your route is marked by yellow signs at the entrances you are to use for each building. If you do not reach your company in ten minutes, they will leave without you. You are to shoot all targets that appear until they fall over or until I tell you to stop.

Figure A-5

Course Layout for CIC Timing and Positions for Simulators



"You will obey all the rules of range safety and in particular make sure your weapon is pointed down-range at all times. Do you have any questions? (the officer makes sure at this point that the subject understands he is to follow the marked path. If subject asks if he is being timed or whether he should run or walk, the response must be such that the subject is not given a "speed set"). Lock and load this clip, take your weapon off safe. All right, move out."

As the subject moves through the course the following things are done by:

(1) The Officer

He starts his clock the moment the man moves out and keeps a running tally of the time the man enters each building and leaves each building. If the man gets off the stipulated course, the officer corrects him and also makes sure that adequate range safety is being followed. When the subject steps through the window of the last building, the officer says, "Stop, clear your weapon, return all unused ammunition to me and sit down by that doorway with the doctor." The officer makes an over-all rating of the man's proficiency in running the course. He uses a 10-point scale approximating a normal distribution such that most of the scores are fours, fives and sixes with an occasional 1 and 10. He knows these men have had no training in Combat-in-Cities, in fact, have never seen a course like it before.

(2) Psychologist

Psychologist controls each of the targets. He raises #1 as the subject steps out of the window of the first building. As soon as it is shot down, the second target over to the left is raised. As subject steps out of the second building the third target is raised. As subject leaves the third building the fourth target is raised and when that is shot down, the fifth target over to the left is raised. As subject crosses the road, the moving target is released. As subject leaves the next building (the one across the road to the left) the sixth target in the last building is raised.

The latency occurring between the appearance of a target and the firing of the first round is recorded. Also, the number of shots fired at each target is noted. If the subject hits the ground for any or all of the six artillery simulators, the place he drops is noted on the score sheet (Card A). At the end of the run the psychologist has the subject cancel Cs for 30 seconds. He thanks him, inquires about fatigue and soreness of feet, and requests that he does not communicate to the other men what has gone on in this course.

(3) First enlisted man

First enlisted man throws the simulators. While the subject is being briefed by the officer, this man loads the simulators in his shirt (3 grenade and 6 artillery) and makes sure the subject is unaware of this operation. The simulators

are thrown at the points marked on **Figure A-7.** The enlisted man resets the moving target.

(4) Second enlisted man

Second enlisted man acts as scorer. After the subject passes through the course, he scores each target for the number of hits. Any nick or hole anywhere on the silhouette is considered a hit.

(5) Third enlisted man

Third enlisted man acts as coordinator. When the testing party is on the far hill, he brings up the next subject who has been waiting on the far side of the road across from Combat-in-Cities. It is most important this man be waiting at this point to prevent his seeing the previous man run the course.

He gives subject two clips of ammo for his cartridge belt and leaves one clip on the parapet for the officer.

There were occasional difficulties due to control wires being shot out by subjects or torn apart by misplaced simulators. This was essentially avoided by running all the wire down the main street out of the line of fire. The tripping mechanisms would occasionally fail to work so that a subject would place four or five rounds in a target before it dropped, was lowered by the experimenter, or he was told by the officer to stop firing and move on.

Comment

This score was deleted from analysis for two reasons. First the speed with which the subject ran the course made it impossible to have the moving target appear at the same place for each subject. A fast man would be well up on the hill by the time the target came into view and in order to hit it, it was necessary for subject to turn his weapon from down-range. Secondly, the heavy rain during the last week caused a large portion of the track to fill in, causing the target to stop in the middle of its run.

Scoring:

The following scores were used for the first analysis:

(1) The mean latency for shooting targets the subject saw,

(2) Number of targets the subject did not see,

(3) The percentage of hits,

(4) The number of times the subject hit the ground for an artillery simulator,

(5) The time it took to run the first building,

(6) Total time to run the course,

(7) Percentage of total time to run first building,

(8) The rating by the officer on tactical proficiency.

PERIMETER DEFENSE

Description

In the Perimeter Defense problem, the subject fired at pop-up targets for ninety seconds, while explosives were detonated close behind and ahead of him. The sequence of events was as follows:

Procedure

(1) When subjects arrive in the area, they are told to sit down and remain at ease behind a defilade which hid the problem from their view. They are processed from this pool, one at a time, through the problem.

(2) When a man is called from the waiting pool, he is first moved out at double time about 100 yards to a spot beside a patch of brush and told to sit down and wait for last minute preparations of the problem. His escort then goes around behind the brush and sets off a grenade simulator behind his back at a distance of ten feet.

(3) After this initial "shake-up" blast, the subject is double timed another 35 yards around the brush patch and into test position. At this point he is taken under control by a second lieutenant and given the following instructions:

"Get into a sitting position here, (indicating) with your weapon pointed down range. Sit so you can reach the ammo. Relax and pay attention to what I say.

"This is a test of your ability to help stop an

enemy attack under artillery fire. Your score will be the number of bullet holes you make in the white enemy targets which will appear to your front at a range of about seventy yards. The targets will rise and fall just as the enemy would. When one appears, make as many bullet holes in it as you can. When it falls, start looking for another target immediately.

"Pay no attention to anything that goes on around you while you are firing. You are in no danger of being seriously hurt provided you obey instructions. Do not, I repeat, Do not at any time turn your face to the side or rear. Keep looking down range at all times. At this time, pull your helmet down to cover the back of your neck.

"Is your rifle zeroed for fifty yards? When I say cease fire, you will lock and clear your weapon, and continue looking down range until I give you further instructions. Have you any questions? Lock and load one clip."

(4) Besides the lieutenant issuing instructions and timing the problem, there are two simulator throwers and one firecracker thrower. The problem runs for ninety seconds, and each simulator man has six simulators to ignite during this time. One man starts the sequence by tossing the first simulator in as the lieutenant commands, "Begin the problem" - following his

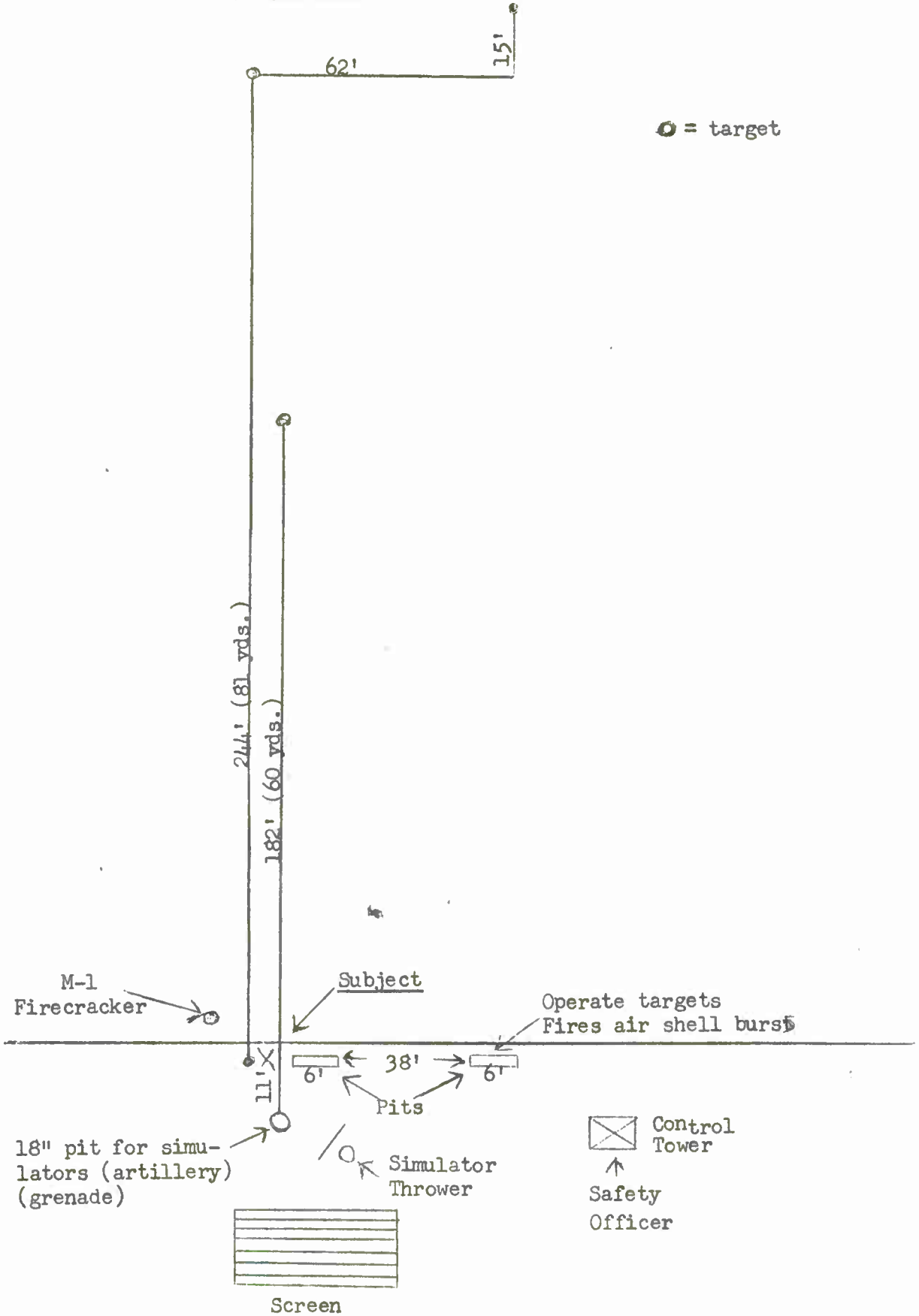
instructions to the subject. The simulator explodes in approximately seven seconds, at which point the other simulator man ignites one and drops it in the blast pit. This alternating sequence is continued for ninety seconds and provides a series of spaced explosions with no long breaks. These explosions occur in eighteen inch blast pits approximately nine feet behind the subject. Meanwhile, the firecracker man has a dozen M-80 firecrackers to throw about eight to ten feet to the subject's front. These are spaced at eight second intervals.

(5) Just prior to giving the command to begin, and after the subject is facing down range and has received full instructions, the lieutenant ostentatiously tells one of the simulator men to "straighten up that fragment shield." The lieutenant then retires into a fox hole, says, "Everybody down behind your shield, take cover" (thus leaving only the subject "exposed" to the explosions and then "begin!" The shields are plywood panels which became scarred and seared by the explosives, thus adding to the dramatic effect.

(6) After ninety seconds of firing, the cease-fire is given, and the number of rounds expended and the number of hits is counted. The subject given Cancelling C's for thirty seconds, asked to rate the stress of the situation, and sent to a spot removed from the first waiting pool to await transportation.

Figure A-6

Perimeter Defense (Field Firing Range No. 1)



LARGE OIL FIRES

General

In attempting to develop a combat substitute, an effort was made to find situations which are known to be stressful but also quite safe. One of the best of these was believed to be the Navy Fire-Fighting School program.

To help in training men to combat ship-board fire, the Navy has establised schools in various parts of the country. One of these is at Treasure Island. Three courses are offered at Treasure Island. One of these is the two-day refresher course, another is a five-day course, while the third is a six-week instructor's course. In these courses, naval personnel receive a good deal of training in actual fire-fighting techniques.

Apparatus

From the situations which the Navy employs, we selected the open-tank fire from the windward side, the boiler-room fire, and the engine-room as being the most promising for our purposes. The engine room was later dropped as not contributing anything beyond the open fire and boiler-room fires. The open-tank fire consists of setting fire to gasoline poured on top of a pool of diesel oil floating on water in a tank approximately 12-15 feet in diameter. When the fire has completely covered the tank, men advance from the windward side with a $1\frac{1}{2}$-inch hose using a standard high-veloxity fog nozzle. This fog nozzle breaks the stream down into tiny droplets which cool the air and the oil and which also turn into steam and smother the fire. As the man advances

towards this tank, the heat, despite the fog nozzle in front of him, becomes very great, with the result that the man has to force himself to go on in and put out the fire.

Procedure (a)

Before the first man actually fights the tank fire, there is at least one "dry run." If the Chief Petty Officer feels the men might need additional dry runs, it is left to his discretion. When he is satisfied that the men fully understand, he starts the first tank fire.

As the man moves in, he plays the nozzle back and forth to cool the air in front of him. When he gets up next to the tank, he then goosenecks the hose turning the nozzle down directly in front of him and sweeps the flames away. He then raises the nozzle and puts out the fire against the other side of the tank.

Score (a)

The men had been divided into groups of five or six, and they were ranked within each group. The man who was most aggressive, or least fearful, in fighting the fire was given the rank of "1," the next most aggressive man the rank of "2," and so on.

Procedure (b)

In the boiler room which is made to resemble the boiler room of a destroyer, the fire is again ignited with a torch after

gasoline has been poured on top of diesel oil floating on water in the bilges. When the fire is burning briskly, the men enter from the fore and aft doors and put out the fire.

Each man is given the opportunity of learning from his dry run before he actually fights the boiler-room fire. The subject is given a great deal of instruction, both inside and outside the boiler room, on the proper handling of the hose.

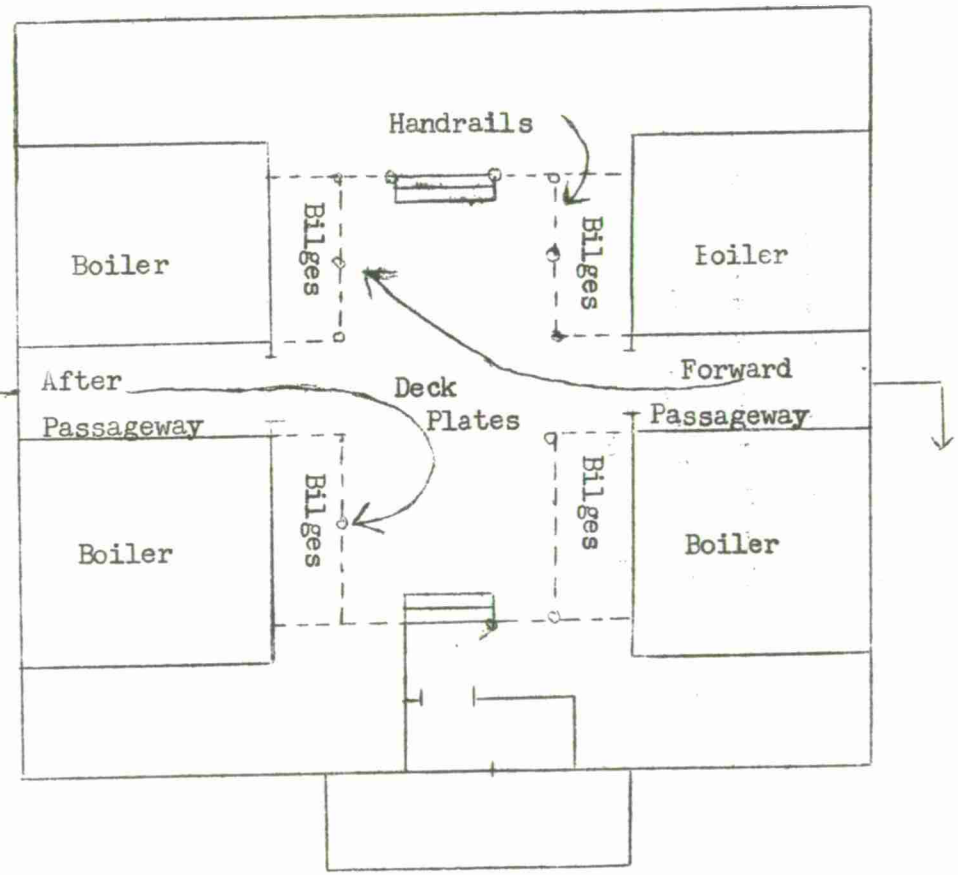
Score (b)

The men were again ranked within their groups by a psychologist and by their chief petty officer instructor. An overall rating was also given, based on having seen the men in both the open-tank fire and boiler room situations.

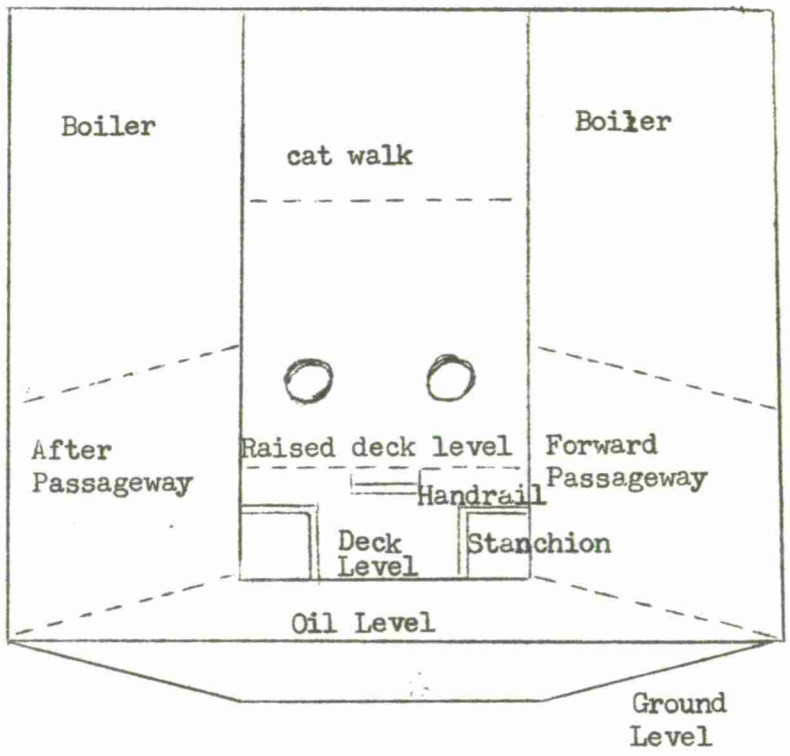
The cancelling C's test is given each man within 30 seconds after he has extinguished the flame in the open tank again after the Boiler Room

Figure A-7

Diagram of Boiler Room



Floor Plan
⊢ = 1 ft.



Cross-Section
⊢ = 1 ft.

SMALL OIL FIRE

General Description

In this test the S's task was to put out an oil fire in a fifty-gallon drum with a water spray from an ordinary garden hose and then to perform the Cancelling C's test.

Apparatus

A. The environment

The testing took place in a sand parking lot about fifty yards from a fire station and cleared for a distance of about fifty feet surrounding the test. Outside of a few cars on a nearby street, there were no apparent distractions.

B. The fire

An ordinary fifty-five-gallon drum was used to contain the fire, with a tap on the side to allow the water to run out after a number of administrations in order to keep the oil level approximately equal for all S's. The drum was filled approximately 3/4 full of water and then five gallons of used motor oil was poured on top. In order to start the oil burning, about a pint of gasoline was added to the drum mixture of oil and water and a match tossed in. Experience during the first two weeks of testing showed that the intensity of the fire depended upon the temperature of the oil and water in the drum; on the third week and thereafter the oil was allowed to begin boiling before the S was told to put it out.

An extraneous variable which had a considerable influence

on the fire was wind. Attempts were made to control this by using windbreaks early in testing. However, these proved unsatisfactory because the wind shifted so frequently and were discontinued following the second week. It never rained while a subject was being tested.

C. The hoses

Two hoses were used, one by the subject to put out the fire in the drum and the other bigger hose was kept handy as a safety measure should the subject accidentally be caught in the flames. The two hoses were supplied with water under 100 lbs pressure through a large fire hose which had a two-way valve between it and the two smaller hoses so that the amount of water flow to each hose could be controlled. The small hose, used by the subject, was an ordinary rubber garden hose with an ordinary garden nozzle attached to the end of it. This nozzle was kept at the finest spray position throughout the experiment. The amount of water in the spray was controlled by the two-way nozzle mentioned previously and was adjusted to give the smallest amount of water which the experimenter thought would put out the fire.

Instructions to S's

Generally, the subjects were brought two at a time to the fire situation. The experimenter then instructed the subjects to place their weapons in some convenient nearby spot and then sent one of them into the adjoining firehouse with instructions to come out in approximately three minutes. E then instructed the S in one of two ways, depending upon whether or not a fire

was already burning in the drum or not. If a fire was not burning in the drum, S was instructed to pour gasoline into a small measuing can used for the purpose until the can was approximately ½ full, to place the contents of the can in the drum and then to take the small measuring can back and put it down. As soon as S was a safe distance away, E tossed a lighted match into the drum, thereby starting the fire. If the fire was already going when S arrived, all of the foregoing pertaining to lighting the fire was dispensed with. At this point the hose was placed ready on the ground upwind of the fire. Instructions were then given to the subject: "All right now, when I give the signal, I want you to pick up that hose, and, leaving the nozzle adjustment exactly as it is, put out the fire as quickly as you can. Be sure to leave the nozzle adjustment just as it is. Wait until I give you the signal." When the experimenter noticed that the oil was boiling, he said, "Go ahead." When the subject had put out the fire, or attempted to for some time, unsuccessfully, he was instructed to "lay down the hose" and was given the Cancelling C's test — allowing one minute in which to do it.

By this time, the other S had usually reappeared from the firehouse and the first S was sent into the house while the entire procedure was repeated with S number 2.

Scoring

During the early weeks of testing, the number of seconds from the go-ahead signal until the time the fire was put out was recorded. However, this measure was discontinued because the experimenter judged that it had no real relation to those things which we wished to measure and was highly related to small variations in nozzle pressure, wind variations, temperature of the oil, and luck, since some of the most frightened appearing individuals put the fires out quickly while others who were more aggressive took longer or failed to put out the fire.

The major score given to each individual was a rank within a group of five or six consecutive subjects. As the subjects were run, the experimenter rated them by putting down such judgments as: "calm, aggressive, very aggressive, extremely aggressive, best, very good, frightened, most frightened, more frightened." After running a group of six, the E took time out to rank the individuals, on the basis of the ratings, from most aggressive to least aggressive and most frightened.

These ratings were quite subjective and based upon such things as: how rapidly the individual approached the fire, S's comments before the fire, S's facial expression, the degree to which S appeared tense or relaxed (a major consideration),

whether or not S jumped when flames licked back at him (also major), and where S stood in relation to the fire.

SHOCK-ARITHMETIC

General Description

The test consisted of five phases. In the first, the subject administered an electric shock to himself, gradually intensifying the stimulus until he no longer could withstand the pain. In the second phase the subject was again instructed to adjust the electric shock for himself, and was informed that his "buddy" sitting next to him would receive the same shock he felt. In phase three, the subject was given 3, 4, and 5-digit examples to add. The experimenter tried to ascertain which type of problem would require a 2 to 4 second latency in order to elicit a correct response. Sixteen examples of this particular type were then presented in the next phase. The subject was not told whether his response was correct or incorrect. In the final period sixteen other addition problems resembling those used in the preceding phase were presented. During this phase the subject was shocked when: (1) a wrong answer was given, (2) a period of four seconds or longer occurred between presentation of stimulus and subject's response, (3) the third, tenth, and fifteenth problem was presented.

Phase I

Instructions

"This machine is capable of giving electric shock. The degree of shock is controlled by moving this red dial. When you turn it slowly to the right, the shock becomes more intense. (Example) Do you feel it? I want you to adjust the shock for

yourself. Turn this dial slowly to the right until the shock becomes too great to stand. When this occurs, remove your hand from the dial; and I will turn it off. Do not turn the dial back under any circumstances. You may start."

Phase II

"Now I want you to again administer the shock by turning the dial; but this time your "buddy", who is also hooked up on the same line, will receive the same shock as you give yourself. Turn the dial until the pain becomes too great to stand."

Phase III

"Mathematical problems will appear in this opening. They will all be addition problems. You are to add them up as quickly as possible and call out your answer as soon as you have it. Ready, go."

Phase IV

"now try these. Ready, go."

Phase V

"Now try these. Ready, go."

Scoring

Each subject was scored on his adjustment to shock in both phase I and phase II. The experiementer ascertained the

type of example which best suited the two to four-second latency requirement, and this group was then employed in phases IV and V. In the latter two phases the subject was scored on the number of correct answers as well as the time required to elicit a response after the presentation of the stimulus.

Appendix B

FACTOR ANALYSIS DATA

No.	Variable
1	Change in Pulse Rate due to stress
2	Undisturbed/disturbed - maze performance
3	Approval/disapproval - mirror drawing
4	Combat-in-Cities time for course
5	Combat-in-Cities % time to reach first building
6	Combat-in-Cities frequency of taking cover from artillery
7	Combat-in-Cities rounds fired
8	Combat-in-Cities mean latency for firing
9	Combat-in-Cities % hits
10	Jump Tower ladder climb
11	Jump Tower latency
12	Perimeter Defense rounds fired
13	Perimeter Defense % hits
14	Small Oil Fire - rating
15	Dark Room movement
16	Dark Room thrust (strength)
17	Dark Room rating
18	Dark Room reaction time
19	Shock-Arithmetic - level of self-shock
20	Shock-Arithmetic - % decrease in accuracy due to shock
21	Shock-Arithmetic - % increase in latency due to shock
22	Shock-Arithmetic - % increase in sustained shock with buddy
23	Treasure Island - open tank rating
24	Treasure Island - boiler room rating
25	Change in Reaction Time due to stress
26	Change in 2-hand coordination due to stress
27	Change in tapping speed due to stress
28	Change in clock estimation due to stress
29	Change in tremor time due to stress
30	Change in tremor contact due to stress
31	Change in weight discrimination time due to stress
32	Change in weight discrimination accuracy due to stress
33	Aptitude Area I
34	Military Information Test
35	Interest Opinion Questionnaire (IOQ) - 1st week of Basic Training
36	Sociometrics - combat rating
37	% change of Pulse Rate - before jumping from Tower
38	% change of Pulse Rate - after jumping from Tower
39	% change of Pulse Rate - after Dark Room performance
40	Eosinophil count - Monday - prior to 29 mile march
41	Eosinophil count - Wednesday - after 29 mile march
42	Eosinophil count - Thursday - after oil fires
43	Total of C's cancelled
44	% change in number C's cancelled - Wednesday (Sum of 6 situations)
45	% change in number of C's cancelled - Tank Fire
46	% change in number C's cancelled - Boiler Room
47	% change in C's omitted - Wednesday (Sum of 6 Situations)
48	% change in C's omitted - Tank Fire
49	% change in C's omitted - Boiler Room
50	Perimeter Defense - change in marksmanship

Table B-1

Product Moment Intercorrelations of Stress Measures (N=100)

	1	2	3	4	5	6	7	8	9	10
1										
2	.019									
3	.031	.025								
4	.046	.041	.068							
5	-.009	-.153	.135	-.203						
6	.124	.052	-.123	.409	-.056					
7	.050	.168	-.040	.014	.084	.045				
8	.161	-.044	-.107	.088	-.181	.165	.030			
9	.276	-.060	.172	.342	-.113	.154	-.232	.087		
10	-.022	.002	.060	-.185	.159	-.078	.045	-.159	-.080	
11	.037	-.117	-.125	-.232	.071	.071	.183	.017	.069	.311
12	.072	-.125	-.018	-.271	.176	.104	.206	-.006	-.173	.111
13	-.045	.105	.071	.104	-.161	-.192	-.300	.022	.074	.004
14	-.119	.064	-.025	.035	.109	-.116	-.067	-.103	-.046	-.023
15	.102	.022	-.025	.123	.023	.105	-.102	-.039	.088	-.055
16	-.133	-.032	.024	.185	-.025	.026	-.304	.041	.149	-.014
17	.010	.038	-.032	.241	-.064	.058	-.222	-.061	.235	-.078
18	-.086	-.129	.012	.246	-.184	.035	.027	.007	.125	-.129
19	-.032	.128	-.183	.104	-.024	.122	-.079	-.057	.096	.060
20	-.050	-.203	.094	-.089	.036	-.241	.048	.111	.029	.002
21	-.111	.129	.023	.140	.061	-.130	.037	-.052	-.009	-.073
22	-.342	.155	.212	.109	-.026	-.024	-.080	-.119	-.089	-.027
23	.167	-.019	-.055	.007	-.014	.044	.023	.052	.046	-.208
24	-.096	.015	.131	-.100	.144	-.070	-.056	.038	-.053	-.151
25	.057	.000	-.029	.114	.007	.045	-.051	-.171	.226	-.024
26	-.088	-.083	.033	-.068	.048	-.106	.000	-.116	-.056	-.136
27	.048	-.004	.094	-.016	-.051	.068	-.194	.036	.117	-.011
28	.050	-.213	-.156	-.015	.029	.091	.118	.076	.065	-.028
29	.087	.057	-.069	-.010	-.130	.067	-.145	.107	.102	-.165
30	.172	.145	.083	-.099	-.078	-.083	.039	-.049	.023	-.123
31	.080	.015	.010	.013	.050	-.143	.091	-.138	.051	-.086
32	.209	.095	.158	-.047	.073	.162	.021	.185	-.092	.008
33	.078	-.007	.081	-.024	.031	-.156	.079	-.174	-.026	.055
34	.108	.032	.084	-.077	.100	-.235	.071	-.193	-.034	.051
35	.021	-.001	.025	-.110	.052	-.205	.002	-.140	.028	.222
36	.082	-.023	.116	.128	-.264	.102	-.027	.128	.038	-.233
37	-.187	.084	.102	.006	-.041	-.204	-.133	-.233	-.082	-.007
38	-.141	.054	.051	.060	-.043	-.032	-.008	-.102	-.018	-.058
39	-.004	.185	.060	.097	-.023	-.027	.040	-.034	.109	-.058
40	-.176	-.019	.251	.064	.051	.038	-.147	-.059	-.055	-.071
41	-.172	-.059	.142	.095	-.034	-.007	-.163	-.027	.032	.001
42	-.109	-.068	.006	-.025	-.130	.051	-.046	-.005	.021	-.109
43	-.008	-.014	-.008	-.191	.280	.081	.143	-.143	-.162	.000
44	.094	.105	.069	-.015	-.194	-.151	.022	-.066	-.005	.127
45	.063	-.032	-.019	.038	-.145	-.136	-.161	.035	-.003	.112
46	.082	.082	-.000	.008	-.153	-.131	-.052	-.053	.013	.096
47	-.071	.078	.109	-.138	.172	-.060	.143	.028	-.169	.208
48	-.056	-.017	.071	-.051	.082	-.007	.123	-.002	-.179	.073
49	.037	.063	.031	-.168	.220	.036	.138	.062	-.127	.166
50	-.099	.075	.012	.098	-.057	.014	.095	-.056	-.078	-.070

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12	.140									
13	-.124	-.466								
14	-.116	.028	.097							
15	-.142	-.074	-.096	.067						
16	-.134	-.252	.109	.001	.312					
17	-.176	-.177	-.003	.061	.733	.713				
18	-.000	-.215	.050	-.062	.096	.275	.355			
19	.069	.086	.057	-.062	.012	-.047	.038	.001		
20	.186	.072	.011	-.033	-.016	-.042	.037	.104	.001	
21	-.132	-.203	.172	.209	.001	.087	.073	-.076	.100	.022
22	-.065	-.166	.168	.144	.085	.052	.061	.050	-.307	-.074
23	.114	.094	-.203	.063	.039	.025	.104	-.041	-.014	.067
24	-.031	.178	-.120	.224	-.048	-.163	-.169	-.232	-.117	.026
25	.024	-.017	.156	.007	-.115	-.059	-.038	.030	.054	.177
26	-.032	.171	-.118	.036	.123	.030	.087	.095	-.074	.000
27	.054	.101	-.005	.135	-.006	-.143	-.029	-.142	.175	-.079
28	.084	.032	.026	.146	.127	.178	.183	.034	-.167	.109
29	.241	-.047	-.001	-.121	.123	.083	.134	.053	-.081	.031
30	.081	-.012	-.090	.087	.096	.053	.065	.105	-.144	.088
31	.026	-.092	.041	.050	.215	.096	.165	.188	-.024	-.015
32	-.000	-.059	.095	.054	.071	-.003	-.074	-.023	-.100	.098
33	.139	.049	.094	-.076	-.007	-.119	-.069	-.286	.060	.215
34	.024	.064	.042	-.063	-.010	-.153	-.095	-.304	.032	.168
35	.289	-.070	.135	-.123	-.066	-.010	-.066	-.259	.168	.059
36	-.133	-.118	-.024	-.044	.022	.096	.056	.227	-.248	.179
37	-.021	-.118	.337	.122	-.156	.045	-.043	-.142	-.036	.-009
38	-.017	-.105	.279	.116	-.077	.050	-.001	-.002	-.044	-.076
39	-.082	-.141	.155	.034	-.080	.009	.020	-.139	.010	-.025
40	-.114	-.097	.106	-.070	.347	.194	.336	.098	-.161	.129
41	-.240	-.077	.250	.035	.010	.131	.160	.039	-.001	-.029
42	-.045	-.031	.137	-.091	.060	.043	.055	-.007	-.053	.040
43	.224	.287	-.159	-.015	-.054	-.139	-.153	-.119	.088	.112
44	-.082	-.097	.159	.018	-.042	-.029	-.014	-.087	-.122	.000
45	-.056	-.114	.210	.173	-.049	.061	.011	-.098	-.115	.000
46	-.059	-.120	.186	.057	-.045	.078	.025	-.130	-.135	-.023
47	.054	.131	-.185	-.042	.018	.015	-.043	-.200	-.005	.064
48	-.082	.183	-.169	-.233	.320	-.121	.100	-.394	-.048	.246
49	.108	.171	-.257	.017	-.032	.032	-.026	-.197	.031	-.080
50	-.108	.157	-.179	-.068	.002	-.119	-.031	-.098	.013	.072
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22	.066									
23	.167	-.053								
24	.020	-.010	.361							
25	.063	-.092	-.035	.026						
26	-.056	.030	.101	.078	.037					
27	.130	-.010	.057	.112	.009	-.104				
28	.087	.060	.084	.041	-.062	-.044	-.150			
29	-.115	.057	.305	.177	-.093	.016	-.076	.057		
30	.028	.142	.298	.193	-.047	.114	-.080	.072	.503	
31	-.017	-.141	-.017	-.104	-.008	-.014	-.063	-.027	-.003	.043
32	.105	-.102	.085	.013	.025	-.058	.011	.189	.036	.143
33	.119	.016	.058	.208	.117	.050	.024	-.001	-.097	-.054
34	-.006	-.042	-.011	.203	.053	-.003	-.136	-.000	-.107	-.084
35	-.013	-.125	-.089	-.097	-.196	-.093	-.022	.030	-.142	-.199
36	.064	.044	.200	.244	-.093	-.103	-.101	.147	.117	.175
37	.193	.135	-.086	.005	.104	.013	-.159	-.185	-.097	.022
38	.132	.018	-.228	.038	.117	.050	-.165	-.018	-.110	-.030
39	.104	.118	-.201	-.066	.115	.073	.000	-.026	-.078	-.034
40	-.065	.218	-.013	.042	.100	.115	.003	-.009	.134	.033
41	.050	.078	.020	.181	.082	-.018	-.013	.000	.076	.026
42	-.026	.047	.080	-.054	.150	.001	-.024	-.027	.165	.217
43	.128	-.020	-.000	-.022	.141	.158	.032	.092	-.120	-.008
44	-.057	.023	.059	.155	-.156	-.031	-.008	-.020	.120	.160
45	.052	.075	.139	.120	-.141	.061	-.055	.041	-.006	.132
46	-.051	-.034	-.016	.035	-.074	-.044	-.037	-.092	.087	.179
47	.046	-.102	.043	.049	-.231	-.085	.224	-.013	-.043	.106
48	.024	-.086	.130	.003	-.541	.192	.124	-.022	.129	.248
49	.036	-.199	.059	-.025	-.136	-.080	.026	.022	-.045	.110
50	.148	.120	.095	.255	.247	.039	-.118	.039	-.150	.197
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32	.028									
33	-.088	-.048								
34	-.153	-.014	.756							
35	.005	-.034	.523	.496						
36	-.164	.153	-.139	-.028	-.306					
37	-.134	-.112	.291	.331	.329	-.111				
38	-.030	-.052	.202	.225	.236	-.032	.698			
39	-.087	-.169	.095	.115	.178	-.162	.401	.363		
40	.141	-.033	.120	.084	-.067	.027	-.007	-.050	-.014	
41	-.125	.007	.105	.058	-.033	.033	.137	.071	.098	.427
42	-.133	.014	.024	.102	-.066	.083	.005	-.080	-.040	.527
43	-.081	.216	.185	.084	.033	-.255	-.073	-.120	-.071	-.017
44	.111	-.155	.146	.116	.059	.135	.073	.052	-.112	-.029
45	-.070	-.111	.170	.164	.119	.116	.204	.185	-.137	-.100
46	.077	-.162	.152	.185	.123	.023	.215	.197	-.065	-.033
47	.040	.135	-.083	-.060	-.044	.039	-.230	-.248	-.046	.035
48	.258	.305	-.022	-.012	-.255	.127	-.099	-.240	.166	.433
49	.082	.156	-.089	-.062	-.074	-.018	-.125	-.157	-.043	-.033
50	.015	-.115	.159	.150	-.033	.065	.070	-.134	-.081	.123
	31	32	33	34	35	36	37	38	39	40

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42	.435									
43	.032	.129								
44	-.004	-.065	-.394							
45	-.019	-.126	-.326	.715						
46	.006	-.016	-.312	.847	.749					
47	.006	.045	.154	.014	-.067	.037				
48	.003	.249	.088	.087	-.236	.119	.399			
49	-.039	-.041	.152	-.112	-.076	-.082	.722	.244		
50	.093	.126	.073	.130	.041	.139	.142	.139	.079	
	41	42	43	44	45	46	47	48	49	50

Table B-2

Rotated Factor Matrix Vn *

	A	B	C	D	E	F	G	H	I	J
1.	-04	-06	-02	-15	00	-03	-01	-47	12	07
2.	-20	10	-11	-07	00	03	-28	-03	08	16
3.	-03	-01	-09	09	-01	12	00	13	04	-04
4.	-04	-28	07	09	09	08	-08	-16	-13	34
5.	12	23	18	-08	05	07	-01	23	-04	-03
6.	-05	-05	09	12	-06	-09	24	-18	01	59
7.	17	26	28	02	-12	02	-13	-01	10	-10
8.	-13	-04	-04	-01	01	-07	16	-43	-11	-10
9.	10	-34	16	-08	16	-06	08	-24	05	13
10.	20	14	-18	-10	08	-27	26	29	06	02
11.	13	-06	03	-20	-02	-17	24	09	58	02
12.	22	31	20	02	-15	10	19	08	-01	08
13.	09	-31	-11	09	-03	-12	-26	-09	-20	-20
14.	-06	-05	07	-18	05	37	-16	24	-08	00
15.	00	18	01	32	47	-02	00	-11	02	06
16.	-10	-03	-10	-02	69	00	-04	00	00	07
17.	-01	01	02	17	76	05	-05	-05	-02	02
18.	-29	-35	09	-12	25	03	01	-02	06	-04
19.	15	00	07	-06	08	-28	04	-08	-16	08
20.	32	-09	16	08	04	07	23	-10	09	-37
21.	08	-04	12	-10	10	29	-13	06	-15	-09
22.	-14	-17	03	11	-10	24	-07	43	24	09
23.	03	03	14	00	07	37	13	-16	28	06
24.	10	01	07	-02	-19	57	09	04	09	05
25.	43	-49	61	-10	-10	14	-09	-04	04	23
26.	03	09	11	17	-01	11	-17	08	03	-08
27.	-01	07	-05	00	-09	-05	18	-02	-20	04
28.	01	-08	05	-10	20	23	19	-04	13	-04
29.	-18	-05	01	13	05	11	04	-10	55	03
30.	-09	11	13	08	11	37	-17	-09	48	-07
31.	-06	08	03	06	17	-10	-14	-10	-02	-20
32.	-03	10	09	05	03	07	05	-30	-02	-07
33.	77	-04	10	14	-04	09	04	03	08	01
34.	68	04	01	15	-08	07	-02	-02	03	-02
35.	62	-09	07	-15	09	-30	-03	02	16	00
36.	-09	-09	-02	06	08	31	16	-31	-03	-10
37.	23	-04	-11	04	-04	08	-49	23	04	-04
38.	16	-08	-05	-03	02	07	-55	09	03	07
39.	11	09	14	09	00	-05	-48	03	-08	-06
40.	25	05	20	73	04	06	08	13	06	09
41.	12	-11	05	38	01	16	03	06	-05	14
42.	09	-06	06	54	-13	05	17	-03	07	12
43.	38	17	53	07	-05	03	06	09	-08	02
44.	03	00	-58	00	-04	14	01	04	19	00
45.	04	-10	-59	-18	05	23	02	08	08	07
46.	10	07	-59	04	03	08	-12	03	09	05
47.	01	60	-14	-10	33	07	28	10	-09	04
48.	-05	72	-08	65	02	-17	-10	-20	05	-24
49.	-02	62	-02	-21	35	08	08	07	-08	17
50.	36	10	32	16	-07	33	-03	09	-03	23
-.10	27	33	28	30	36	28	26	33	35	37
Σa^2	2.63	2.41	2.30	2.01	1.88	1.72	1.66	1.39	1.38	1.08

*decimal points omitted

Table B-3

Unrotated Factor Matrix Vo*

	A	B	C	D	E	F	G	H	I	J	h^2
1	21	-42	-11	03	08	-01	04	05	30	13	35
2	09	-08	-02	07	01	16	-28	-03	09	22	18
3	10	11	09	08	-06	-08	-10	00	-09	-08	07
4	00	-18	31	-02	-04	00	-05	36	-07	31	36
5	-09	21	-09	-08	10	16	16	-26	-14	01	22
6	-06	-19	22	-26	-20	-13	09	03	22	50	52
7	01	01	-14	-04	-08	34	21	-28	06	14	29
8	10	-39	-02	-19	03	-16	05	03	09	-09	24
9	-01	-14	15	-03	12	-03	17	37	18	11	27
10	-34	26	-09	13	10	-18	10	-21	16	-04	33
11	10	25	-22	05	07	-09	16	-07	59	-03	52
12	01	05	-15	-11	-10	03	32	-44	-08	09	36
13	-16	-11	04	30	-05	08	-10	41	-15	-19	37
14	17	17	-04	05	15	04	-10	05	-35	11	23
15	-02	-05	62	-09	13	11	-01	-05	07	-13	45
16	-08	05	57	-02	45	01	-16	20	06	-03	61
17	-05	03	76	-05	41	10	-05	18	00	-15	82
18	10	09	19	-27	22	-06	-15	44	05	-04	40
19	-35	-09	-02	-04	07	08	17	04	07	09	19
20	13	02	-01	07	05	-08	39	-01	00	-44	38
21	11	02	01	08	16	08	06	05	-33	-01	17
22	20	44	12	01	-16	-03	-22	15	-09	03	35
23	50	-08	10	-04	06	-07	14	-13	10	03	32
24	51	-01	-07	14	-09	-17	10	-17	-26	09	44
25	-01	06	-06	05	-02	28	49	46	-05	30	63
26	08	09	09	02	-08	20	-01	-06	-11	-10	10
27	-12	-08	-06	-12	-06	-16	06	-11	-11	05	10
28	27	02	12	-05	20	-18	09	02	02	-06	18
29	46	06	18	-07	-06	-02	-12	03	42	-09	46
30	61	04	14	03	05	19	-07	-12	19	-11	50
31	-04	-05	09	-06	11	18	-04	01	03	-21	11
32	18	-26	03	-14	02	02	11	-11	03	-07	15
33	-06	03	03	63	-08	07	50	-08	-03	-07	68
34	-05	-05	00	63	-11	07	39	-14	-05	-09	60
35	-35	08	-15	50	14	19	39	06	30	-01	70
36	40	-28	16	-07	05	-24	03	04	-11	-12	36
37	-06	15	-02	59	-04	31	-16	11	-14	00	53
38	-04	02	01	52	03	38	-18	20	-08	15	52
39	-15	01	00	18	-03	50	-04	05	-11	00	32
40	-02	20	63	-02	-39	11	19	-02	-10	-22	70
41	05	05	40	07	-22	-04	04	12	-18	-01	27
42	10	01	39	-05	-41	-10	09	03	-01	-11	36
43	-16	14	-07	-19	-04	32	53	-22	-14	03	54
44	24	-06	02	60	-04	-36	-31	-08	09	-06	67
45	21	-06	00	64	11	-43	-31	02	-03	07	76
46	11	-11	09	69	-02	-23	-32	-09	05	-01	67
47	-05	02	10	-14	29	-15	08	-66	-05	01	58
48	02	-17	31	-14	-30	30	-04	-64	11	-44	94
49	-07	-01	05	-16	35	08	05	-62	-02	22	60
50	11	06	12	11	-13	17	33	-17	-25	20	33

*decimal points omitted

Table B-4

TRANSFORMATION MATRIX

	A	B	C	D	E	F	G	H	I	J
A	-12	10	10	55	-05	05	81	-04	-02	02
B	-13	-10	13	-05	08	23	-21	-92	-01	-05
C	26	19	-02	-36	-04	49	66	24	-11	14
D	-04	-07	58	00	-74	14	04	-11	-02	-29
E	-09	00	55	00	82	05	-02	-07	09	-07
F	77	17	11	11	13	-01	14	-05	-51	24
G	-07	11	09	-24	-02	-81	46	-14	17	-02
H	-13	93	-03	11	-03	-09	-15	-13	-22	14
I	51	46	02	13	-06	10	05	-01	70	01
J	-04	08	33	03	-19	-11	07	-06	15	90

Table B-5

COSINE OF ANGULAR SEPARATION

	A	B	C	D	E	F	G	H	I	J
A										
B	-14									
C	34	-29								
D	13	17	02							
E	01	23	-09	-25						
F	12	-09	35	-12	04					
G	23	-13	-06	-02	02	-07				
H	05	04	-03	-10	-05	29	06			
I	09	-11	18	00	-02	13	05			
J	14	-01	08	06	-02	15	18	18	15	

Decimal points omitted

Appendix C

INFLUENCE OF A PARTNER ON TOLERANCE FOR A SELF ADMINISTERED ELECTRIC SHOCK[1]

by

Irwin Miller
Stanley B. Bensen
Dennis Seidman
Tor Meeland

The purpose of this study was to investigate the effect of one person's presence on another person's ability to endure the stress of a painful stimulus, an electric shock.

Several observers have reported on social influences on performance under stress and the ability to tolerate stress. In an account of combat performance, Marshall (4) describes how men become demoralized under barrage. He relates this to the feelings of isolation the men experience as they lie flattened on the ground. An important finding was that morale could be sustained, however, if NCO's and Jr. Officers would move among the men calling out their names. If this was done, units could continue to fight effectively when the barrage was lifted.

In another report, dealing with psychiatric casualties, Mandelbaum (3) cites evidence showing that "good outcomes" are facilitated if men can be returned to their units for treatment rather than sent away from the combat zone to rest camps. This increased "good outcome" rate, in the face of the same external stresses that originally precipitated the psychiatric breakdown, is viewed as resulting from the support provided by identification with the combat units and its purposes.

Apart from observational accounts, a few experimental studies employing animal subjects are noteworthy. The Ross's (5) study of feeding behavior in dogs, and Vogel et al's (6) study of maze-running, also using dogs, showed that, in the presence of another animal, a dog will eat more, and run faster in a straight alley maze. In addition, frequent changing of partners resulted in a decrement in maze performance (7).

An animal study by Davitz and Mason (2) featured conditions somewhat similar to those of the present study. They studied the effect of one animal's presence on the strength of fear response exhibited by another animal. Defining fear response as a "tense, immobile crouching position" or "freezing" (2 (p. 149)), they observed rats that were placed in a box where a blinking light had been previously associated with electric shock. They found that the rats were significantly more active in response to the light when an unconditioned rat was placed in the box with them, than when observed alone. On a basis of the activity criterion, they concluded that the presence of a nonfearful rat produced a significant reduction of

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[1]Presented before the Western Psychological Association, March 29, 1956.

the fear response.

The present study was included in a military research program exploring various experimental stress situations. The greater part of this program had to do with field-type situations such as putting out a blazing oil fire at a Navy fire-fighting school, jumping from a high tower like those used in Paratroop and Ranger training, and going through a Combat-in-Cities course.

At the outset, Marshall's finding was acknowledged; that the quality of individual performance under actual combat stress can vary greatly depending on morale factors such as a man's physical and social contact with other men of the unit. In this field research, however, it was not feasible to focus attention on social conditions which affect performance under stress. We found that such an assessment was handicapped by limitations in research personnel, and by the fact that many devices involved procedures that would easily get communicated to succeeding groups of subjects. The present study was an exception. It was not a field test and circumstances were such that subjects entered the situation without access to knowledge of it. This test was designed to compare the difference in tolerance for electric shock when subjects were tested alone, and when they were tested in the presence of another subject who apparently received the same electric shock.

METHOD

Subjects

The sample consisted of 133 men who had completed eight weeks of basic infantry training and who were due to continue with eight weeks of advanced infantry training. The age range for this group was 17 to 28; mean age was 20 years and 2 months. Mean intelligence was 101.35 as assessed from the Army Aptitude Area I scores, a test of general intelligence in Z-score form with mean equal to 100 and a standard deviation of 20.

From 20 to 30 subjects were tested each week for a period of six weeks. During the first three weeks, testing order was "shock alone" followed by "shock with partner." Testing order was reversed during the second threeweeks.

Apparatus

The source of the painful stimulus was a "Constant Current Electronic Stimulator" (Model 228, Applegate & Co.) having a current range and cor-

responding meter reading of 0 - 5 milliamperes. Current was delivered at 60 cycles for a standard rectangular wave. The stimulator was set for continuous current. The experimenter controlled the "on-off" switch which was relocated out of sight of the subject while the subject controlled the current intensity.

The electrode consisted of two silver discs coated with electrode paste secured with an elastic band to the subject's right calf.

Procedure

Two determinations of tolerance for electric shock were made for each subject. In one, the subject was alone with the experimenter. In the other, the subject believed that a partner was also in the circuit. For both determinations, the subject himself increased the amperage to the highest level he felt he could tolerate. His instructions were to remove his hand from the current control when he reached this level. This was the signal for the experimenter to interrupt the shock.

For the condition involving a partner, the subject was told that another subject, who had been brought in and seated next to him, would simultaneously receive a shock of exactly the same intensity. However, the partner received no shock even though electrodes were also attached to his leg. Since the subjects were tested successively, the experimental arrangement permitted us to employ each subject as an unwitting accomplice during the testing of the next subject.

RESULTS

Differences between (a) the two shock conditions, (b) the two presentation orders, and (c) the six successive weeks of experimenting were tested for significance by an analysis of variance. In addition, the analysis provided a means for testing whether interactions occurred between either the shock conditions and the presentation orders, or the shock conditions and weeks of experimenting. Since presentation order and week of testing were confounded, two alternative breakdowns of the data were made for the purpose of testing all interactions. A summary of the analysis of variance is given in Table 1.

When the differences between the shock-alone and shock-with-partner conditions were tested by the alternative error terms, Fs of 31.28 and 30.85 were found, indicating that the mean differences were significant beyond the .001 point. The mean current setting for the shock-alone was

Table 1

Analysis of Variance: Intensity of Electric Shock for Two Experimental Conditions, Two Presentation Orders, and Six Weeks of Testing

Source	df	MS	F
Orders	1	21202.54	-----
S/Orders	131	40757.09	
Weeks	5	89018.19	2.30*
S/Weeks	127	38703.08	
Total Between Ss	132		
Conditions	1	133315.88	31.28**
Conditions x Orders	1	4227.30	-----
S/Orders x Conditions	131	4261.56	
Conditions	1	133315.88	30.85**
Conditions x Weeks	5	2740.30	-----
S/Weeks x Conditions	127	4321.18	
Total Within Sx	133		
Total	265		

* P = .05.
** P = .01 or less.

3.13, while the mean setting for the shock-with-partner was 3.58.

The differences between the two presentation orders were not significant, F being less than 1.00. Consequently, there is no reason to think that presentation order had any bearing on the results of the different shock situations. This conclusion is substantiated by the non-significant shock x presentation order interaction. Here also, F was less than 1.00.

When the overall differences among the six weeks of experimenting were tested, an F of 2.30 was found, showing that the weeks differed significantly at the .05 point. The mean current settings during the six weeks ranged from 2.66 in the first week to 4.12 in the second week. However, since the shock x weeks interaction proved non-significant with an F less than 1.00, the differences among weeks plainly had no effect on the differences observed under the two shock conditions.

DISCUSSION

Under the present experimental conditions, we found that the presence of a partner acted to raise a subject's tolerance level for electric shock significantly beyond the tolerance level yielded when the subject was tested alone. A point of no small interest is the fact that the partner received no shock while the subject under observation shocked himself. To the best of our knowledge, the partner did not learn that he would not be shocked until the trial was essentially concluded. Apparently the change in stress tolerance was mainly a result of a relationship perceived by the subject between himself and the partner which did not, in fact, exist. Confirmation of this point awaits further research in which the "shock-with-partner" condition reported here may be compared with a new condition in which a partner actually does receive an electric shock.

Our results may be interpreted in several ways. On the one hand, the presence of a partner in a stressful situation might act to raise shock-tolerance by producing competitive behavior. On the other hand, the partner may provide reassurance about the ability to tolerate stress. Davitz and Mason (2 (p. 151)) suggest a balance between competitive drive states as the explanation for their results, with the introduction of a partner tending to reduce the fear drive by creating a sort of disinhibiting distraction.

If we generalize our concept of stress, an analogy may be drawn between the present study and recent investigations by Asch (1) regarding the influence of group pressures on an individual's judgement of a perceptual stimulus. Asch found that in the absence of outside corroboration a person

may experience great difficulty in resisting a pre-arranged group judgement that is deliberately made contrary to his own sense-testimony. However, the presence of one outsider who substantiates the subject's judgement greatly increases the Subject's ability to resist the pressure (or stresses) imposed by the group towards conformity.

SUMMARY AND CONCLUSIONS

As a part of a program seeking combat substitutes for military research, the presence of a partner was explored for its effect on stress-tolerance. Tolerance for electric shock was measured by having each subject increase the shock intensity to the maximum that he could tolerate. Two observations were made for each subject; one when he was alone, and another when a partner apparently shared the electric shock while the subject raised it to his maximum tolerance level.

Analysis of data on 133 enlisted men showed that the tolerance level chosen in the condition including a partner was significantly higher ($p < .001$) than the level chosen when the menware alone with the experimenter. It was further shown that his result was not influenced by order of presentation and week of testing. These findings indicate that the perceived sharing of stress contributes importantly to stress-tolerance.

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Appendix D

CORRELATIONS BETWEEN PERSONALITY TESTS RESULTS AND PERFORMANCE IN STRESS PRODUCING SITUATIONS

1. S.I. = Composite Stress Index (ă priori)
2. CIC = Combat in Cities
3. JT = Jump Tower
4. DR = Dark Room
5. PD = Perimeter Defense
6. Shock = Arithmetic - Shock
7. T.I. = Treasure Island Oil Fires (Tank and Boiler Room)
8. Factor B = Deliberate Accuracy Under Stress (C's)
9. Factor C = Stress Performance Index (Cancelling C's)
10. Factor H = "Autonomic Efficiency" or "Emergency Reaction"

(N = 80 - 120)

No.	Master Index	Test	Variable	Stress Situation									
				SI	CIC	JT	DR	PD	Shock	TI	B	C	H
1.	01.20	CPI	Tolerance	.09	.13	.17	.19	.03	.04	.11	.00	.01	.22
2.	01.15	"	Responsibility	.16	.10	-.04	.10	-.11	.00	.10	-.07	.15	.15
3.	01.19	"	Social Status	.11	.09	.29	.31	.01	.07	.08	.03	-.05	.31
4.	01.04	"	Dominance	.09	.02	.09	.13	-.11	.08	.10	-.07	-.01	.23
5.	01.17	"	Social Participation	.09	-.04	.18	.24	-.09	.00	.13	-.10	.08	.26
6.	01.05	"	Femininity	.00	.17	-.22	-.13	.18	.13	-.05	.06	.13	-.06
7.	01.02	"	Delinquency	-.01	.07	-.03	.07	.10	-.14	-.01	-.05	.06	-.07
8.	01.12	"	Intellectual Efficiency	.10	.01	.18	.20	-.10	.06	.01	-.08	.07	.27
9.	01.09	"	Honor Point Ratio	.23	.12	.03	.22	.10	.05	.13	.06	.00	.26
10.	01.14	"	Psychological Interests	.11	.12	.18	.22	-.02	.17	.01	-.01	.06	.19
11.	01.08	"	Graduate School Potential	.15	.13	.08	.15	.08	.02	.08	.02	-.05	.21
12.	01.18	"	Social Presence	.07	-.07	.28	.24	-.08	.02	.04	-.10	.05	.34
13.	01.10	"	Impulsivity	-.15	.12	.06	.09	.09	-.17	-.07	-.24	-.04	.05
14.	01.16	"	Self Acceptance	.04	.06	.15	.19	-.01	.00	.03	-.24	-.04	.22
15.	01.11	"	Infrequency	-.03	.12	-.05	-.07	.05	.04	-.09	.18	.00	-.04
16.	01.03	"	Dissimulation	-.19	.05	-.09		.07	-.17	-.08	-.02	-.03	-.07
17.	01.13	"	Neurodermatitis	-.00	.11	-.10		-.03	.09	.16	-.15	-.01	.19
18.	08.04	MIT	Weapons	.16	-.06	.10	.20	-.26	.06	-.02	-.07	-.10	.02
19.	08.05	MIT	Tactics	.08	-.11	.03	.16	-.17	.04	.00	-.06	-.03	.05

No.	Master Index	Test	Variable	Stress Situation							(Factors)		
				SI	CIC	JT	DR	PD	Shock	TI	E	C	H
20.	03.01	Humor	Factor 1-Debonaire Sex	.05	-.18	.05	.15	.05	-.17	-.08	-.04	-.08	.19
21.	03.02	"	Factor 2-Play vs Dry Wit	.16	.14	.06	.24	-.16	-.09	.16	.07	.14	.23
22.	03.03	"	Factor 3-Tough Self Composure	.13	-.02	-.09	.19	.07	.03	.11	.19	-.02	.21
23.	03.04	"	Factor 4-Gruesomeness	.21	.13	-.12	-.15	-.04	.23	.15	.09	-.03	.07
24.	03.05	"	Factor 5-Hostile Derogation	.13	-.04	-.11	-.01	-.05	.02	.31	-.06	-.07	.01
25.	03.07	"	Factor 7-Cold Realism	-.04	.04	.03	.02	.12	-.05	-.09	-.16	-.12	.25
26.	03.08	"	Factor 8- Ponderous Humor	.23	.12	.18	.11	.25	.13	.17	.19	.01	.12
27.	03.09	"	Factor 9-Whimsical Retort	.12	.07	-.09	.05	.03	-.11	.09	.28	-.04	.05
28.	04.02	16PF	Factor B- Gen. Intelligence	.18	-.05	.05	.02	-.11	.00	.03	-.01	.03	.19
29.	04.03	"	Factor C- Emotional Stability	.16	-.01	.06	.14	.06	-.16	.03	-.17	.09	.07
30.	04.08	"	Factor I-Emot.Sens. vs Matr.	.06	-.01	.17	.01	.07	-.07	.10	.12	.08	.02
31.	04.11	"	Factor N-Soph. vs Rough Simp.	.26	-.09	.07	.24	-.19	-.07	-.06	-.30	.12	.15
32.	04.12	"	Factor O-Anxious Insecurity	.07	.12	.18	-.02	.39	.08	.03	.09	-.04	.02
33.	04.16	"	Factor Q4-Nervous Tension	.07	.24	.15	.15	.22	.03	-.01	-.01	-.09	-.12
34.	32.02	IOQ	1st Week Basic	.03	-.02	.34	.14	-.11	.10	.10	-.16	-.02	.09
35.	05.07	Strong	Veterinarian	-.14	.15	.10	-.02	.07	.06	-.06	-.16	-.04	.01
36.	05.10	"	Engineer	.00	.04	-.06	.05	-.01	-.10	.01	-.09	.04	-.01
37.	05.11	"	Chemist	.12	.04	-.05	.20	-.02	-.16	.06	-.20	-.04	.03
38.	05.14	"	Aviator	-.08	.23	.09	.10	-.04	-.01	-.06	-.06	-.05	-.07
39.	05.19	"	Voc. Agriculture Teacher	-.23	.15	.03	-.07	-.05	.09	-.19	-.21	-.10	.04
40.	05.20	"	Policeman	-.15	.28	-.05	.13	-.39	-.11	-.19	-.30	.08	-.03
41.	05.21	"	Forest Service Man	-.12	.23	-.02	.13	-.25	-.01	-.18	-.07	.02	-.02
42.	05.33	"	Office Man	-.16		-.14	.03	-.16	-.03	-.16	.12	.06	-.08
43.	05.35	"	Banker	-.06		-.09	-.04	-.18	.16	-.17	-.12	.05	-.14
44.	05.47	"	Masculinity-Femininity	-.05		.03	.10	-.02	.01	-.09	-.09	-.16	-.09
45.	20.01	Baron Ink Blots	Clear Human Movement	.18		-.12	.23	-.08	.11	-.15	-.08	-.10	.22
46.	20.03	" "	Total Human Movement	.15		.05	.26	-.10	-.01	-.29	.13	-.10	.33
47.	09.	Sociom.	Ht.	.10		.04	-.04	-.15	.17	-.01	.10	-.07	-.01
48.	09.	"	In squad -2nd 8 weeks	-.10		-.22	-.13	-.08	-.03	-.19	.12	-.26	-.46
49.	09.21	"	Combat	-.04	-.08	.16	.19	.04	-.04	.28	.08	-.19	-.51
50.	09.	"	Clean Barracks	-.10			-.13	.06	-.02	-.14	.18	-.06	-.36
51.	09.71	"	Leader in Combat	-.10			-.24	.05	-.00	-.22	.18	-.22	-.43
52.	09.	"	Home	-.03			-.02	.05	-.17	-.19	.09	-.13	-.38

D130

No.		Test	Stress Situation							Factors		
			SI	CIC	JT	DR	PD	TT Shock	TT	B	C	H
53.	09.	Socio. Fire in troop ship	-.07			-.25	.01	-.03	-.21	.21	-.17	-.44
54	09.	" Sq. Ldr - 2nd 8 weeks	-.03			-.19	.04	-.01	-.15	.13	-.25	-.51
55.	17.01	WSI Word Suggestion Inventory	.00			.05	-.05	-.01	-.05	.06	-.04	.08
56.	7.1	Abil. to state assumptions	.00			.28	-.15	-.11	-.21	-.09	.01	.00
57.	9.1	Lo Rig: Hidden Words	.13			.15	-.23	-.07	-.02	-.11	.11	.13
58.	11.1	Tendency to ck. obvious remarks	.19			-.06	.09	.23	.04	.16	-.02	.13
59.	14.1	Decision Time	-.03			.10	-.02	.02	.15	.02	.31	.28
60.	15.1	Knowledge of etiquette	-.05			.07	-.21	.10	-.03	.04	-.08	.17
61.	18.1	Abil. to surg. Classifications	.08			.19	-.11	-.01	-.03	-.11	.06	.13
62.	20.1	Physical Adjustments	.20			.25	-.01	.09	.17	.01	-.04	.22
63.	21.5	Dispersion of aspr. level	.02			.05	-.19	-.04	-.03	-.02	-.19	.28
64.	21.6	Dispersion of coding performance	.06			.06	-.18	-.01		-.11	.08	.31
65	22.5	Fast speed - line judgment.	.03	.11	.05	.07	.03	-.04	.12	-.05	.22	.05
66.	23.1	Social Good Taste								-.05		
67.	24.1	Th. objects I (% total)	.13	-.12	-.03	.10	.03	.17	.05	-.05	.01	.18
68.	24.2	Th. objects II	.05	-.05	.12	.01	.00	-.08	-.05	-.03	-.10	.00
69.	24.3	No. obj. perceived in ambigious sketches	.14	.05	.08	.20	-.10	.02	.17	-.02	.14	.14
70.	25.3	Memory for phrases	.19	-.15		.20	-.16	.00	.13	-.10	.08	.21
71.	27.2	Speed in clerical task	.10	.00	.10	.08	.01	-.05	.11	-.11	.24	.20
72.	27.3	Accuracy in clerical task	.12	-.08	.05	.14	-.20	.03	-.001	-.04	.15	.19
73.	28.5	Perceptual Closure Speed (I plus II)	.13	-.05	.02	.17	-.04	.06	-.01	.10	-.05	.25
74.	32.2	Attn. to detail in copied design	.05	-.08	.02	.20	-.16	-.03	.06	.16	.21	.12
75.	36.4	CMS no. of correct decisions	.14	.01	.04	.11	-.02	.05	.07	.00	.16	-.17
76.	36.5	CMS % correct decisions	-.02	.04	.00	-.08	.07	.04	.02	.10	-.14	-.10
77.	36.6	CMS - Total Score	.13	-.09	.03	.16	-.08	.04	.13	-.21	.01	.19
78.	72.1	CFF	.11	-.02	-.09	-.01	-.08	.13	.11	-.06	-.03	.17
79.	75.2	2 hand coord. speed	-.11	.02	.10	-.00	-.10	-.01	.00	-.10	-.06	.16
80.	78.2	Ataxia	-.03	-.15	-.06	-.08	-.13	-.12	-.11	.12	-.06	.02
81.	79.1	Ectomorphy	.14	-.08	-.15	-.06	-.14	.01	-.12	.09	.16	-.05
82.	79.2	Mesomorphy	.32	.21	.24	.28	.12	-.07	.18	-.09	.08	.56
83.	80.5	Change in diastolic blood pressure	-.08	.06	-.03	-.05	.02	-.01	.02	-.06	-.05	.01
84.	80.7	Change in pulse rate due to stress	-.02	.13	-.04	.04	.07	-.08	-.10	-.19	-.07	-.54
85.	83.5	P.G.R. initial resistance	-.01	-.04	-.11	-.10	.01	-.07	-.04	.05	-.02	-.12
86.	86.2	No blind alleys enteres - maze	-.12	.14	.04	-.17	.29	.07	.07	-.09	.08	.01
87.	86.4	Long exploratory distance on maze	-.19	.20	-.03	-.19	.32	.01	.11	-.13	.10	-.02
88.		OT Factor 4	-.03	-.01	.15	.04	-.11	.18	.03	.21	-.04	.23
89.		OT Factor 7	-.01	.02	.18	.08	.18	-.17	.00	-.17	-.02	.11

Appendix E

SUPPLEMENTARY MATERIAL AVAILABLE UPON REQUEST

Staff Memorandum of Human Research Unit No. 2, CONARC,

A Detailed Description of the Test Batteries Used in FIGHTER II,

by Tor Meeland, November 1956.

Contents:

This material is available upon request to the Office of the Director, Human Resources Research Office, Post Office Box 3596, Washington 7, D. C.